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STUDIES IN THE CONTROL OF SCRUB TYPHUS.

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WHEN at the end of 1942 the Director-General of Medical Services, Australian Military Forces, received information from the United States of America (Madden, Lindquist and Knipling, 1944) that dimethyl phthalate offered valuable protection against "chiggers", attack by larval mites (commonly called "scrub itch" in Queensland and "mokka bites" in New Guinea) was a well-known feature of jungle training and warfare, while scrub typhus had already caused some hundreds of Australian casualties.

The hitherto accepted method of clothing treatment for "chigger" control was by sulphur impregnation (Ewing, 1921, 1925). The American report, however, was to the effect that, under severe conditions, sulphur was disappointing, allowing some biting in a matter of hours, while several new mosquito repellents were extremely effective. Dimethyl phthalate was considered the best, having given protection in the field for at least five days. The only method of application described provided a treated band half an inch wide at all entrances to clothing, with a wider band on the socks. No precise dosage was quoted, but the implication was that the bands were heavily treated.

Dimethyl phthalate had recently been selected as the mosquito repellent to be issued to Australian troops (McCulloch and Waterhouse, 1946). The writer, as officer in command of a mobile entomological section of the Australian Army Medical Corps, was given the project of examining its application against Australasian trombiculids. These studies had the prime object of controlling scrub typhus in the field by protecting troops against infestation by mites. They were founded on two basic propositions:

1. That the disease was mite-borne. This, accepted by most medical authorities (for example, Manson-Bahr, 1940), was questioned by Cook (1944) on theoretical grounds, but has been confirmed by the United States Typhus Commission (Blake, Maxcy, Sadusk, Kohls and Bell, 1945).

2. That the troops most requiring protection were those in forward fighting areas. Any control measure had therefore to be simple and to require a minimum of material and special equipment.

The investigations, as they finally developed, have taken the following forms: (i) field tests of impregnated clothing, (ii) studies of the toxicity to mites of treated cloth, (iii) investigation of methods of applying treatment to clothing, (iv) instruction of troops in the use of anti-mite fluid, (v) studies of scrub typhus statistics, and inquiries with the object of assessing the value of recommended methods, (vi) surveys of mite populations and studies in mite behaviour, which led also to observations on locality disinfestation.

The various projects were carried on alternately or concurrently as requirements at the time appeared to indicate. On occasion the principal investigation (clothing treatment) was temporarily suspended in favour of mite surveys, with the object of enabling troops to avoid danger areas. As soon as enough was known of the potentialities of the phthalates, and sufficient supplies were available to justify their general use, research gave way to the work of instructing personnel, after which laboratory studies were resumed to investigate certain points not previously clarified or new problems brought forward by field experience.

Always effort was expended in the direction which at the time promised earliest returns in the form of reduction in incidence of scrub typhus. For this reason examination

of all details of the use of dibutyl phthalate was preferred to a search for alternative miticides or life-history studies of Trombiculids.

The work began in Sydney in March, 1943, and was continued in South Australia, Queensland, New Guinea and Borneo. The most important developments occurred at Dobodura, New Guinea, during the period from August to October, 1943. Experience in the instruction of troops and the management of dibutyl phthalate in the field was gained notably in the Ramu Valley and Finschhafen areas between November, 1943, and January, 1944, while at Lae during the period of February and March, 1944, records were compiled and patients were interviewed, the information gained allowing assessment of the value of dibutyl phthalate to a force in action against the enemy. At Lae, and later in North Queensland, investigations confirmed or clarified many details of the performance of the phthalate in cloth.

FIELD TESTS.

Experiments in Australia.

The Australian work began with the exposure of volunteers to attack by *Acomatacarus australiensis* (synonym *Leeuwenhoekia australiensis* Hirst; Womersley, 1945) at Sydney, and continued at Robe in South Australia with *Trombicula samboni*, known locally as "tea-tree itch". Both these localities had the great advantage of offering mite attack without fear of scrub typhus. When mites showed reduced activity with cold weather, the work was moved to the Atherton Tableland in tropical Queensland, where "scrub itch" was well known and some cases of scrub typhus had occurred. Volunteers were chosen from among men who had had scrub typhus in the previous six months, as it was believed that they possessed some degree of resistance. They were exposed to *Trombicula minor* (Figures I and II) in an area where a great deal of "scrub itch" existed with no history of scrub typhus.

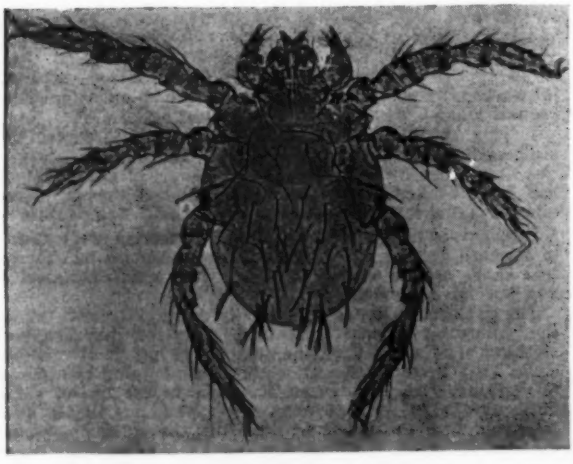

FIGURE I.
Trombicula minor Berlese.

Studies were confined to Australian military tropical uniforms: woollen socks, canvas anklets or gaiters, and cotton trousers and shirt. Treatment of cotton underclothes was considered and later recommended, but was not in fact tested.

The method of testing was as follows. Thick patches of mites were sought for by men in treated clothes walking in line through promising country, standing still from time to time, and marking "rich spots" where at least twelve to twenty mites appeared on the boots in two minutes. Later, parties of eight to ten men wearing test clothes sat and lay among the mites for at least two hours of each day, accompanied by two men wearing untreated clothes, who, however, were exposed for not more than one hour. It was found that this treatment caused the mites to be fairly rapidly reduced in numbers, apparently by their migrating onto the men. Accordingly the test party moved at intervals of half an hour to other rich spots found in the preliminary survey.

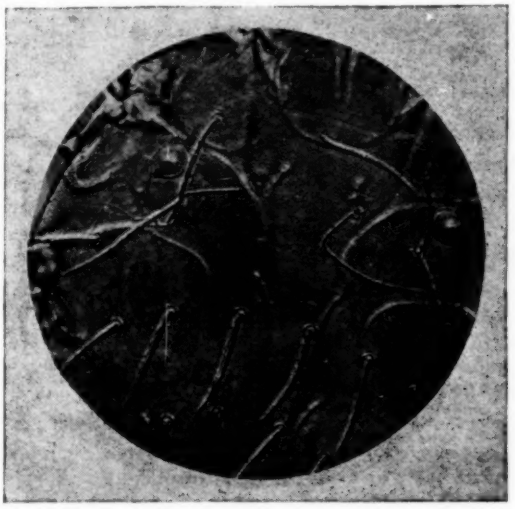

FIGURE II.
Trombicula minor Berlese (scutum).

Some puzzling results were obtained, in that, while "untreated" men usually received 50 to 300 bites, on some occasions they were not attacked. At the time this was attributed to erratic activity on the part of the mites induced by cold weather; but it was later realized that it was mainly due to the resistance of even light dosages of phthalate to being washed from the clothes. Exposures in which "untreated" men experienced no biting were discarded. By June, 1943, the following observations had been made.

Tests at Sydney against Acomatacarus Australiensis.

1. The protection afforded by dimethyl phthalate was indeed most impressive; 2·5 millilitres, sprinkled evenly over socks (about 1·25 millilitres per square foot of clothing area) and rubbed in, appeared to protect men standing among the mites for at least three days; 18 millilitres and 24 millilitres, sprinkled evenly over shirt, trousers and socks (about one millilitre and 1·25 millilitres respectively per square foot), appeared to protect men sitting or lying among mites for at least two days.

2. The treated band method of application was inferior to complete cover of the clothes; 2·5 millilitres applied to socks in a band three inches wide (about four millilitres per square foot of treated material) allowed biting on the first day. Two and a half millilitres, applied to gaiters only (1·25 millilitres per square foot), allowed biting on the first day; the use of twelve millilitres applied to socks and to shirt and trousers in the form of a four-inch band at all entrances (3·5 millilitres per square foot of treated cloth) was considered to have failed when many mites climbed onto the heads of sitting personnel within half an hour.

3. At the dosages used the phthalate was toxic rather than repellent. Mites crawled freely onto treated clothing, but after an hour's exposure many were found dead or moribund in such situations as in the socks and in folds on the front of trousers and under the shirt collar. In the laboratory, mites were placed in a glass dish topped by a one-inch wall of blotting paper saturated with dimethyl phthalate. In a matter of seconds some had crawled onto the top of the treated blotting paper, while others had

crawled onto it and then returned to the glass. All were replaced in the dish, and soon seemed unwilling to attempt to climb out again. When next they were examined five hours later, all were dead. In a similar dish without phthalate, from which mites were prevented from escaping by "Tanglefoot", they lived in the laboratory atmosphere for at least six days.

4. Dibutyl phthalate appeared to be as effective as the dimethyl compound. It was tried because it was known to be more readily available in Australia, while there seemed to be little prospect that dimethyl phthalate could be produced in quantities required for clothing treatment.

Tests in South Australia against Trombicula Samboni.

Against *Trombicula samboni* both phthalates gave protection for at least four days, when applied at the rate of seven millilitres to socks and gaiters for standing personnel and fourteen to twenty millilitres to shirt, trousers and socks for men sitting among mites. Attention was directed to minimum dosages rather than to longer protection.

Tests at Atherton against Trombicula Minor.

Some tests against *Trombicula minor* were carried to eight days, while in others attempts were made to simulate the effects of wading through streams. The following observations were made.

That dibutyl phthalate gave protection to standing personnel for at least four days, when seven millilitres were applied to the whole of socks and gaiters, was confirmed. When applied to give full cover to socks, trousers and shirt, ten millilitres (0·5 millilitre per square foot) protected sitting men for at least four days, while fifteen millilitres and thirty millilitres both gave protection for at least eight days, all clothing being unwashed for that period. The application of twenty millilitres, tested after "rinsing" of clothes, and of thirty millilitres, tested after "severe rinsing", both gave protection for at least eight days. "Rinsing" involved soaking in cold water (72° F.) for five minutes, with agitation for one minute, then draining for five minutes, followed by a repetition of the soaking with further agitation for one minute. "Severe rinsing" involved the same two periods of five minutes' soaking, except that vigorous agitation continued throughout the period of immersion.

Dimethyl phthalate gave similar results, except that the application of ten millilitres to socks, trousers and shirt, and that of twenty millilitres after "rinsing", both broke down on the second day of the test. With these treatments one and two men respectively experienced six to twenty bites by *Trombicula minor*, the majority of mites being dead though attached. In a test to investigate the possibility of protection in the absence of socks, twenty millilitres of dimethyl phthalate applied to the shirt, the trousers and the inside of boots, the shirt and trousers being not washed, protected two men till the end of the test at eight days.

Comment.

Dibutyl phthalate thus appeared superior to the dimethyl compound as a miticide for clothing treatment. From the point of view of supply it was undoubtedly to be preferred, though no large-scale issue could be expected for some months.

Experiments in New Guinea.

DDT.

Research in clothing treatment was resumed at Dobodura in August, 1943, primarily with the object of evaluating DDT, of which experimental quantities had been received from the United States of America. Its performance against body lice gave reason for hope that, at a dosage of five grammes per set of clothes, it might give protection against mites for some half-dozen washings. Two Australian hospitals were establishing camps in a kunai flat surrounded by jungle. The troops experienced considerable mokka-biting by *Schöngastia pusilla*, *Schöngastia blestowei* (Figures III and IV) and *Trombicula minor*, and surveys showed that these and other species could be found in moderate numbers on the boots throughout the grass country and more densely but patchily in jungle. The general use of dimethyl phthalate (on issue as mosquito repellent) for socks and trouser bottoms was ordered. Mokka biting decreased sharply.

Large numbers of men of one of the units volunteered to act as test subjects in the experiments. They were to

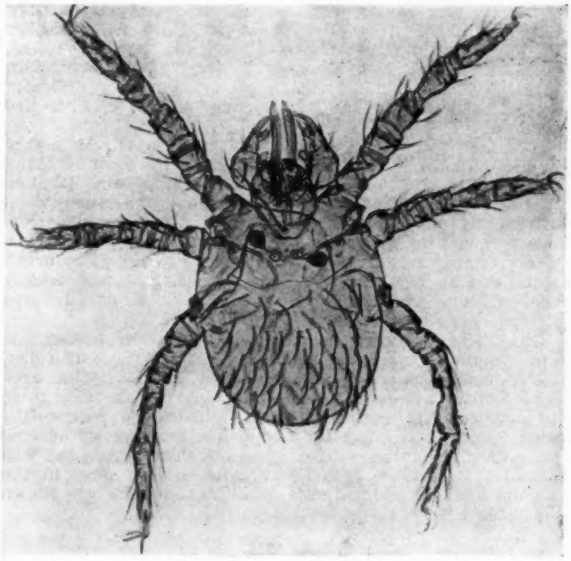

FIGURE III.
Schöngastia blestowei Gunther.

FIGURE IV.
Schöngastia blestowei Gunther (scutum).

wear treated or untreated clothes as decided by the drawing of lots, to refrain from using dimethyl phthalate, and to proceed with normal duties, which consisted mainly of clearing grass and scrub from the camp area. That men should volunteer for such research was most creditable, in view of the fact that a man from one of the units

had died of scrub typhus before the first experimental team was selected. Justification of the policy of asking them to volunteer was the view that their risks from scrub typhus were no greater than those of all troops in New Guinea prior to the issue of dimethyl phthalate.

Thirty men were selected, their names were drawn against numbers, and they were allotted to five groups. In each of the four test groups, all clothing possessed by the men (three sets) was treated. Oil solutions of DDT were sprinkled over the spread-out clothes by shaker bottle. The dry powder was carefully applied to all parts of the cloth by means of a scrubbing brush, an increase to 7·5 grammes being decided on when difficulty was experienced in getting a complete cover with five grammes.

The men were engaged in considerable labour in a very humid climate. The majority wished to wash clothing daily. For the experiment the clothing was labelled "set 1", "set 2" or "set 3", and the sets were worn alternately and washed after each day of wearing. For the majority of men this involved the use of soap in a clear running stream, the clothing being scrubbed by brush and hand on logs or rocks. As this method was usually the only one available to forward troops, it was adopted as the only one for test personnel.

No biting occurred for the first week, except for one man (eight bites) in the untreated group on the fifth day. It seemed apparent that the men's duties in an area where mites were now hard to find were not exposing them to sufficiently severe conditions. Deliberate exposure—the men sitting and lying for two hours per day in selected patches where mites were thick—was then begun, but was confined to treated groups only and to four days in the second week after treatment. The final results are shown in Table I.

TABLE I.

Dosage of DDT per Set of Clothes.	Observations.
5·0 grammes in 6·0 ounces of kerosene.	Clear biting after four washes of the clothes. Suspicious marks thought to be due to attachment of moribund mites after two and three washes.
5·0 grammes in 4·0 ounces of petrol.	Results as for first group.
5·0 grammes in 5·0 ounces of petrol and kerosene (equal mixture).	Clear biting after two, three and four washes.
7·5 grammes of powder.	Clear biting after two and four washes.

DDT and Dibutyl Phthalate.

These results with DDT being relatively disappointing; and observation of mites on cloth having shown that dibutyl phthalate was not completely removed by washing, a second field experiment was begun with three groups of three men each. The repellents used were: (*a*) DDT, 18 grammes in kerosene; (*b*) dibutyl phthalate, 30 millilitres; (*c*) dibutyl phthalate, 45 millilitres.

Each lot of 18 grammes of DDT was dissolved in 24 ounces of kerosene in a bottle from which the solution was poured onto the clothes; this gave immediate saturation without run-off. The phthalate was applied by temporary emulsion from a shaker bottle. No controls were provided. All men spent two hours a day sitting on the ground among thick mites and moving every half-hour.

At an examination three hours after the end of a period of exposure to mites following the fourth washing of the clothes, two of the three men wearing DDT-treated clothes had mites on the skin. The mites were found as follows: (i) first man: two attached (one alive), one free on skin, one free on sock; (ii) second man: 27 attached alive, 27 attached dead, three alive free; (iii) third man: twenty-four hours after exposure following the third and fourth washes of the clothes suspicious marks present, though no mites were found attached. The DDT-treated group was no longer exposed. The two dibutyl phthalate treated groups continued daily exposure to plentiful mites until after eight washes of clothes (twenty-two days), when the experiment ended because of military movement; none had bites.

DDT, Dimethyl Phthalate, Dibutyl Phthalate.

It was then realized that dimethyl phthalate on cloth could also resist some washing, and that personnel in the last-mentioned experiment were wearing clothes which, prior to the test, had been treated (socks and trouser bottoms only) with this repellent after each wash. A third experiment was therefore run concurrently with the later stages of the second. One set of new clothes was provided for each of nine men. After being washed to remove newness, the clothes were treated in groups of three, as follows: (*a*) DDT: eighteen grammes per set; (*b*) dimethyl phthalate: one fluid ounce per set; (*c*) dibutyl phthalate: one fluid ounce per set.

The clothes were then worn daily in the mornings by men exposed to plentiful mites and were washed in the afternoons. Exposures were for six hours before the first wash, and for two hours after the first, second and third washes, when the experiment ended because of military movement.

The results were as follows:

DDT.—Three hours after the end of the exposure that followed the third wash, one man had seventeen live mites attached on his ankles. From the beginning two men had shown suspicious marks, such as had developed on others where mites were found attached and dead. However, at daily examinations three and twenty-two hours after exposure, no mites had been found on these men.

Dimethyl Phthalate.—When examined three hours after the end of exposure following the third wash, one man of the three had five mites attached and dead on his ankles.

Dibutyl Phthalate.—No signs of biting were found.

Comment.

Summarized, the results of these field tests at Dobodura were as follows:

1. DDT. When five grammes in a kerosene-petrol mixture were used, biting occurred after two washes. When five grammes in kerosene were used, biting occurred after four washes. When five grammes in petrol were used, biting occurred after four washes. When seven and a half grammes of powder were used, biting occurred after two washes. When eighteen grammes in kerosene were used, biting occurred after three washes.

2. Dimethyl phthalate. When one ounce was used, extremely limited biting occurred after three washes.

3. Dibutyl phthalate. When one ounce and one and a half ounces were used, no biting had occurred at the end of exposure after eight washes.

Though the tests have the obvious weakness of small groups and inadequacy of controls, they were regarded as showing protection by dibutyl phthalate for the following reasons: (i) the clear and continued activity of the mites under the strikingly uniform conditions of the jungle climate; (ii) the biting which occurred in other groups in the test parties; (iii) the confirmation of resistance by dibutyl phthalate to washing seen in a large series of tests in cloths carried out concurrently with field tests (*vida infra*).

Because of the risks to men in field experiments in typhus country, no more were attempted. DDT and dimethyl phthalate, with their supply difficulties and indicated comparative failure, were discarded. Dibutyl phthalate, in view of its newly discovered resistance to washing, was reallocated to mite control and made available to troops progressively by areas as supplies allowed.

TOXICITY STUDIES ON CLOTH.

Development of the Method.

Cloth testing was developed during field experiments at Dobodura. It had been seen at Sydney and Atherton that mites crawled onto phthalate-treated clothing and died. When first wearing DDT-treated clothes at Dobodura, the writer induced mites moving upward from the hand to

crawl on the outside of the shirt sleeves. They were paralysed in about ten minutes. Some were then placed on untreated clothes not being worn, and again they were paralysed in about ten minutes. It was then realized that all these clothes had been treated with dibutyl phthalate before arriving at Dobodura, and that the phthalate had probably retained its toxicity through at least two or three washes.

Cloth tests then began with foot-square pieces treated with DDT, dimethyl phthalate and dibutyl phthalate. The area of shirt, trousers and socks was estimated as twenty square feet, so that an application of 1·4 millilitres per square foot was referred to as "one-ounce dosage" or the equal of one fluid ounce per set of clothes. Mites were lifted by camel-hair brush from boots to cloth, prevented from escaping by turning and folding of the cloth, and timed until they lost the power of movement. None of the species examined could penetrate drill trousers or shirt material, though they readily passed through woollen socks and partially buried themselves in woollen serge.

On untreated cloth, mites ran actively for thirty or forty minutes, though relatively sluggishly at one hour; beyond this time they were not at first taken. On DDT-treated cloth they were sometimes lost while still active after forty-five to sixty minutes, but occasionally they were watched up to two hours when still moving.

On phthalate-treated cloth mites ran actively for a few minutes, and then quickly lost speed and direction, eventually losing the power to move from place to place, though still waving their legs. The "stopping time" came to be adopted as the standard—the time after arrival on the cloth at which a mite became incapable of moving one millimetre in half a minute. The "stopping time" was adopted, because "earliest visible effect" provided too vague a standard, while observation of "cessation of all movement" would have wasted time. On a cotton cloth giving a stopping time of twenty minutes, loss of speed would become apparent at about five minutes, by which time the mite would have travelled at least one foot. In the second five minutes it might move two inches, and in the final ten minutes an inch or so. "Stopped" mites (*Schöngastia pusilla*) lifted to untreated cloth were on several occasions observed to die, though this aspect of the matter was not fully studied.

At first, single mites were tested on khaki or green cloth, and few readings were made. Later, white cotton and navy-blue wool cloths were also used, and the mites were controlled two, three and four at a time by the writer and also by men who acted as volunteer test subjects in the field experiments. Subsequently "mite watching squads" of men wearing treated clothes were provided by various Australian Army Medical Corps units. The largest group employed consisted of six men, with one to check stopped mites and record times. Magnifying spectacles were available, but many young men controlling two or three mites at a time preferred to work without them. Abundant mites in or near jungle shade were required, so that a man could at any time pick up three or four from his boots in a minute.

From time to time considerable effort was devoted to attempts to replace the watching of mites on treated cloth by mechanical means, which promised the testing of large numbers simultaneously by comparatively few men. Mites bogged in variously arranged barriers of "Ostico" (a special tanglefoot), ordinary "Tanglefoot", or petroleum jelly, crossed zinc oxide plaster, and were rendered torpid by barriers consisting of cylindrical tin moats filled with iced water. When confined by Petri dishes or watch-glasses placed on the cloth, they spent much time on the glass.

The most successful of these methods depended on using two pieces of similarly treated cloth. The first was fixed over a ring (such as the top of a jam tin) and depressed in the middle to form a shallow dish. The second cloth was stretched across a metal ring of wider diameter. The mites were placed in the dish in the first cloth and covered by the second, the weight of the ring confining them between the two pieces of material. The method was useful for untreated controls kept undisturbed for long periods, but in toxicity tests some mites would be lost if they were inspected before becoming lethargic.

Finally, in Queensland, the technique of cloth testing was greatly improved (Figures V and VI). Cloths in squares of (preferably) fifteen inches were pinned on sheets of ply-wood, and considerable numbers of mites

FIGURE V.
Brushing mites onto test cloth. (Photograph Military History Section.)

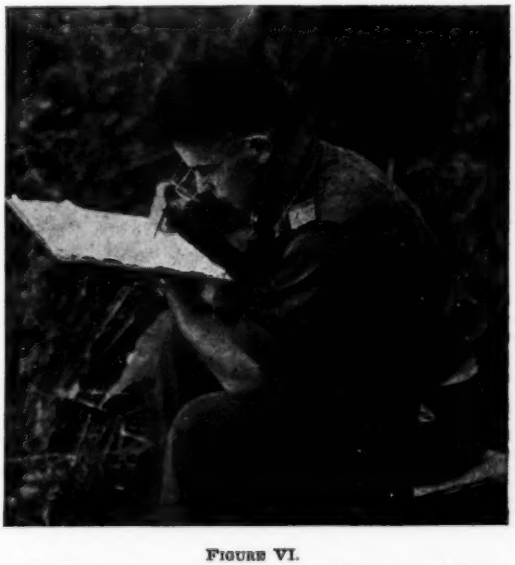

FIGURE VI.
Controlling mites on test cloth. (Photograph Military History Section.)

were placed in the centre of each. Left alone, the mites would scatter, eventually reach the edge of the cloth and be lost. Their migration was delayed by slow rotation of the boards (held horizontally), the rotation causing the mites repeatedly to reverse their direction of travel. The outer three inches of cloth were watched through magnifying spectacles, and the mites appearing on it were picked up on fine camel-hair or feather brushes

moistened with saliva, and returned to the centre. Experience indicated that this handling had negligible harmful effects. As activity declined, stopped mites were collected in groups and counted, and the time was noted.

The advantage of this method was that it allowed a man to control commonly twenty, and as many as fifty, mites at a time. As the number placed on the cloth was known with only approximate accuracy, extreme care was required that none escaped, since any to gain the edge and be lost would presumably be the most resistant individuals.

The method was made readily practicable by the dense mite populations encountered at Atherton, and by collecting them from inert objects, such as specacle cases, rather than from men's boots, on which many mites are lost to the treated socks.

After stopping, mites were usually tubed in 75% strength alcohol for identification later. This was done by mounting them in alcohol under a cover-slip, and when no abnormality in stopping time had been recorded, as many as forty were mounted at once. The work was done where one species predominated. In the alcohol, "strangers" could be recognized as such, picked out and mounted in gum chloral (Womersley, 1943) or polyvinyl alcohol for specific determination.

Climate and Mite Longevity in Relation to Cloth Tests.

The uniform climatic conditions encountered were considered an important factor in the reliability of cloth tests, which were always carried out in jungle shade where air movement was slight. In New Guinea, a long series of records showed that extremes during tests (9 a.m. to 4 p.m.) were temperatures of 80° F. (relative humidity 85%) and 88° F. (relative humidity 75%). Occasionally at intermediate temperatures the relative humidity fell as low as 70%.

At Atherton, relative humidity was almost always less than in New Guinea and the temperature was more variable, but by avoiding occasional clear, hot days for tests, it was arranged that extremes experienced (as shown by at least two readings per half-day) were 75° F. (relative humidity 90%) and 87° F. (relative humidity 50%), and that the great majority of tests were performed at temperatures between 78° and 82° F., with a relative humidity of 60% to 75%.

During tests mites were kept from time to time in dry test tubes, watched on untreated cloth, or confined on untreated cloth by mechanical means. Stopping in less than three hours was never observed. This, and the fact that tests frequently included some cloths of declining toxicity on which mites moved for more than one hour, were regarded as proof that factors other than intoxication played no important part in stopping times of less than one hour.

Species of *Schöngastia* and *Trombicula* were, however, observed to be extremely susceptible to desiccation. specimens of *Schöngastia pusilla* in dry test tubes in jungle shade were usually moribund in four to six hours. When moist blotting paper was added they lived for two or three days. *Schöngastia blestowei* on untreated cloth in the jungle rarely moved for more than five hours. When kept in moist earth in a test tube, the majority of a population of this species were fully active at two weeks, and some individuals lived for forty-six days.

Trombicula minor in Queensland proved less dependent on a high humidity, but in the usually drier climate could not live away from the soil for notably longer periods. Some 50 to 100 individuals in dry test tubes in the jungle at 80° F. and 60% relative humidity showed no mortality at three hours. When they were taken to a tent in which the temperature reached 87° F. and the relative humidity 36%, about half were dead at eight hours. A few survived to thirteen hours, by which time the temperature had fallen to 76° F. and the relative humidity was 70%.

Method of Recording Results.

Field records were kept in the form shown in Table II. The figures in parentheses are the numbers of mites observed.

Field records were consolidated on laboratory charts to show minimum, maximum and mean stopping times and number of mites used for each cloth after each wash. Examples of such charts are given in Tables III, IV, V and VI.

Interpretation of Cloth Tests.

Earliest cloth tests in New Guinea indicated that, when one ounce was used, there was little change in toxicity of dibutyl phthalate treated cloth until after at least seven cold water washes, while on dimethyl phthalate treated cloth, stopping times lengthened abruptly to more than sixty minutes after the third wash. Corresponding field tests with men in treated clothing gave the following results: (i) dibutyl phthalate: no biting to the end of exposure which followed the eighth wash; (ii) dimethyl phthalate: slight biting after the third wash. From this it was assumed that stopping times in excess of sixty minutes on phthalate-treated cloth probably corresponded to breakdown of protection on treated clothing.

A second reason for adopting a maximum of sixty minutes as the end point in cloth tests is found in the form of the curve of stopping times. For *Schöngastia* on cloth treated with dibutyl phthalate (Tables III and IV), the curves of mean stopping times rarely showed any important rise until a sudden upward turn, which occurred never before the sixth and almost invariably after the eighth or later wash. This sudden change was regarded as indicating the loss of effective toxicity. It generally coincided with the first recording of a maximum of sixty minutes or more, and later tests were therefore not carried beyond the hour.

The reaction of mites on the skin under treated clothing in practically still, saturated air at a temperature of 98° F. is not necessarily the same as when they are exposed on a piece of cloth to gently moving air at 85° F. and a relative humidity of 75%, and no explanation is offered as to why they should not bite if they survive for periods up to forty-five minutes. Nevertheless, the cloth tests, through the limited association with field tests mentioned above, and through surprisingly consistent results over many months with thousands of mites, came to be regarded as a convenient measure of the probable performance of various related treatments in the field. To have worked out all the problems associated with clothing treatment on active service by means of field trials would have required a great deal of time and an immense number of test personnel.

TABLE II.

Cloth.	Operator.	Start. (Hours.)	Stop. (Hours.)	Stopping Time. (Minutes.)	Tube Number.	Later Identification.
M1-10	X	0921	0931 (5) 0934 (14) 0939 (15)	10 (5) 13 (14) 18 (15)	1	*Trombicula minor.*
M1-26	Y	0923	0931 (3) 0936 (6) 0938 (11) 0941 (5) 0954 (2) 1000 (2) 1018 (1)	8 (3) 13 (6) 15 (11) 18 (5) 31 (2) 37 (2) 55 (1)	5 11 3	*Trombicula minor.* *Trombicula minor.* *Acomatacarus* sp.

TABLE III.

Readings made at Dobodura in October, 1943, the Mites being Schöngastia Pusilla Tested on White Cotton Cloth Treated at Dosages of Dibutyl Phthalate Corresponding to 0·5, 1·0, 1·5 and 2·0 Fluid Ounces per Set of Clothes.

Dosages.	Stopping Times and Numbers of Mites.	Number of Washes.								
		1	2	3	4	5	6	7	8	9
0·5 ounce of pure fluid applied by hand.	Minimum ..	12	12	11	12	8	8	9	10	Over 60
	Maximum ..	15	12	12	20	15	33	44	106	78
	Mean ..	13	12	11	16	12	16	18	32	Over 70
	Mites ..	4	4	4	4	8	19	21	19	4
1·0 ounce of pure fluid applied by hand.	Minimum ..	8	13	7	11	6	7	10	8	47
	Maximum ..	8	13	9	12	14	15	32	37	109
	Mean ..	8	13	8	11	10	12	17	22	Over 80
	Mites ..	2	3	4	4	8	19	23	28	8
1·5 ounces of pure fluid applied by hand.	Minimum ..	12	7	7	11	11	8	6	8	12
	Maximum ..	12	7	12	18	13	22	19	34	75
	Mean ..	12	7	8	14	12	14	12	18	40
	Mites ..	3	2	4	4	4	12	16	20	7
2·0 ounces of pure fluid applied by hand.	Minimum ..	6	7	7	14	14	4	6	8	14
	Maximum ..	6	7	12	16	16	16	24	16	95
	Mean ..	6	7	9	15	15	10	13	13	33
	Mites ..	2	2	4	4	4	12	13	22	13
1·0 ounce, applied in factory-made emulsion.	Minimum ..	14	8	7	9	11	9	8	7	9
	Maximum ..	14	15	13	17	19	14	24	30	68
	Mean ..	14	10	10	13	13	11	15	17	32
	Mites ..	2	3	6	4	4	13	20	28	17
2·0 ounces applied in factory-made emulsion.	Minimum ..	5	8	5	7	6	7	5	8	10
	Maximum ..	5	10	16	10	16	14	17	26	63
	Mean ..	5	9	8	8	12	11	12	16	26
	Mites ..	2	3	6	4	3	13	15	21	18

Studies of Dibutyl Phthalate.

Factors bearing on the use of dibutyl phthalate examined by means of cloth tests were: (i) methods of washing, (ii) dosage, (iii) method of application, (iv) method of drying, (v) application to inside or outside of garments, (vi) application to new cloth, (vii) application to waterproofed cloth, (viii) application to different kinds of cotton cloth, (ix) application to cloth already wet, (x) wetness of cloth at time of test, (xi) the effect of sweat, (xii) storage after treatment, (xiii) attempts to increase resistance to washing, (xiv) differences between cotton and wool, (xv) different forms of dibutyl phthalate, (xvi) species variation in susceptibility to phthalate.

Methods of Washing.

As was stated earlier, washing by forward troops in New Guinea usually took place in a stream. Soap was not always available, and when it was used no such concentration of lather could be built up as is possible in a bucket or dish. In settled camps most washing was done in buckets with cold water and soap (bar or powder). Frequently the clothes were wetted, spread on a flat surface, rubbed with soap and then scrubbed with a stiff brush. Another method consisted in soaking them in soap solution overnight and then rinsing them after limited rubbing. Boiling was not common. Laundry washing was virtually confined to hospitals.

For cloth tests, washing, unless otherwise stated, involved hand-rubbing with the use of bar soap in abundance of cold water (80° to 85° F.) followed by quick rinsing in two clean waters. All such washing was done by the writer. Complete standardization could not be achieved; but rubbing and working of the cloth was certainly more severe than that experienced by each square foot of the average bucket-washed garment and a great deal more severe than that of stream-washed articles. When a number of cloths were washed at one time, care was taken that fresh water was used for each dosage of dibutyl phthalate.

Variations from normal washing tested against the application of one ounce of dibutyl phthalate were as follows:

Cold Water.—The use of "Persil". The use of a scrubbing brush. Routine ironing of the cloth after each normal wash. Prolonged soaking with limited rubbing in strong lather. Prolonged soaking with rinsing in water without soap.

Warm Water.—Normal washing, but with water at 100° F.

Hot Water.—Boiling in soapy water.

A laundry wash was used for green uniforms.

None of the modifications of cold or warm washing produced signs of breakdown of protection earlier than did normal washing. The "soaking in lather" involved, at each wash, fifteen hours in soak followed by plunging and squeezing but no knuckle-rubbing, before removal to the clean rinsing water. Test results are recorded in Table V. The cold-water rinsing consisted of soaking for six hours on each of seven days with rubbing in the water for one minute on each occasion. Stopping times recorded subsequently for *Schöngastia blestowei* were ten to seventeen minutes, with a mean of thirteen minutes for eighteen mites.

The results observed with hot washing were as follows.

After four boilings of ten minutes each in soapy water, cloth treated with one ounce of dibutyl phthalate showed breakdown of protection against *Schöngastia pusilla*. After three boilings the cloth had been still strongly toxic, giving stopping times of two to thirteen minutes with a mean of eight minutes for sixteen mites.

Laundry washing was not examined until included in an experiment at Atherton in February, 1945 (Table VI). With the mites occurring there (*Trombicula minor*), breakdown of protection of cloth treated with one ounce of the phthalate was usually seen after five normal washes. The object of the experiment was to test a graduated series, as follows: (i) hand-washing, mild (squeezing only for one minute in lather without rubbing); (ii) hand-washing, moderate (normal washing); (iii) hand-washing, severe (four times as much knuckle-rubbing as in normal washing); (iv) brush scrubbing, moderate (normal); (v) brush scrubbing, severe (four times as much scrubbing as in (iv)); (vi) laundry wash used by a hospital laundry for green clothes (two ten-minute washings in a machine with soap solution at 135° F., followed by three machine rinsings totalling fifteen minutes).

Two types of cloth were treated: (*a*) one treated with one ounce, hand applied; (*b*) one dipped in an emulsion of 2·5% dibutyl phthalate in 0·5% soap solution. The experiment was carried past the third wash before being abandoned through movement overseas. At that stage (Table VI), hand-treated cloth had shown no important differences in reaction to the various cold washes, but suggestive lengthening of stopping times after two launderings and clear breakdown of protection after three

TABLE IV.

Readings Made at Lae in March, 1944, the Mites being Schöngastia Blestowei on White Cotton Cloths Treated as Described.

Treatment with Dibutyl Phthalate.	Stopping Times and Numbers of Mites.	Number of Washes.							
		7	8	9	10	11	12	13	14
One ounce; first wash six hours after treatment.	Minimum ..	5	12	6	12	8	35		
	Maximum ..	13	17	17	15	46	72		
	Mean ..	10	15	12	13	17	50		
	Mites ..	15	10	8	11	20	4		
One ounce; first wash one day after treatment.	Minimum ..	8	12	13	32				
	Maximum ..	22	35	21	Over 78				
	Mean ..	14	18	17	Over 65				
	Mites ..	22	21	15	6				
Five ounces; first wash one day after treatment.	Minimum ..				10	53			
	Maximum ..				33	Over 60			
	Mean ..				18	Over 60			
	Mites ..				19	3			
Five ounces; first wash one week after treatment.	Minimum ..	7	11	10	10	14	30		
	Maximum ..	27	26	22	29	35	60		
	Mean ..	15	17	15	20	21	45		
	Mites ..	22	15	15	20	19	12		
Five ounces; autoclaved before first wash.	Minimum ..		12	11	14	9	10	17	16
	Maximum ..		34	26	26	32	37	53	Over 62
	Mean ..		19	19	21	17	20	30	Over 50
	Mites ..		16	23	21	37	22	22	8
Ten ounces; first wash one day after treatment.	Minimum ..		9	7	7	24	Over 90		
	Maximum ..		19	32	27	42	Over 90		
	Mean ..		11	18	13	34	Over 90		
	Mites ..		8	16	11	5	3		
Ten ounces; first wash one week after treatment.	Minimum ..		9	8	5	6	8	27	
	Maximum ..		27	14	20	19	33	33	
	Mean ..		13	11	13	13	17	30	
	Mites ..		8	17	12	8	15	10	

TABLE V.

Readings made at Atherton in November and December, 1944, the Mites being Trombicula Minor. Cloths in Series A, B, C, D, E, F, were Treated by Hand with Dibutyl Phthalate (One Ounce) and, with the Exception of D (Soaking), Washed Normally in Cool Water. Series G, H, I and J were Treated as Described.

Treatments.	Stopping Times and Numbers of Mites.	Number of Washes.							
		0	1	2	3	4	5	6	7
A. Three cloths: normal treatment and washing.	Minimum ..					15	45		
	Maximum ..					60	Over 75		
	Mean ..					34	Over 70		
	Mites ..					50	14		
B. Three cloths: repetition of *A.*	Minimum ..	6	8	8	15	7	12	9	22
	Maximum ..	13	18	16	20	29	34	61	46
	Mean ..	8	14	12	17	15	22	23	29
	Mites ..	31	44	33	40	78	41	86	73
C. Two cloths: repetition of *A.*	Minimum ..		10	9	8	11	18		
	Maximum ..		15	15	23	27	Over 60		
	Mean ..		13	12	14	18	Oevr 37		
	Mites ..		64	59	36	51	31		
D. Two cloths: washed by soaking overnight in strong lather without severe rubbing	Minimum ..		15	12	15	10	10		
	Maximum ..		18	17	23	22	29		
	Mean ..		16	15	19	18	19		
	Mites ..		38	51	34	53	45		
E. Two cloths: ironed before first wash.	Minimum ..		12	6	7	11	13		
	Maximum ..		20	19	19	34	Over 60		
	Mean ..		15	11	12	19	Over 33		
	Mites ..		22	27	37	65	37		
F. Two cloths: ironed after each wash.	Minimum ..		10	10	10	18	12		
	Maximum ..		13	17	23	33	57		
	Mean ..		11	13	14	20	25		
	Mites ..		33	38	27	45	52		
G. Two cloths: dipped in dibutyl phthalate emulsion (2·5%); normal wash.	Minimum ..		14	6	10	12	6	22	
	Maximum ..		17	32	22	30	37	47	
	Mean ..		15	18	16	24	25	36	
	Mites ..		33	22	41	52	48	27	
H. Two cloths: dipped in dimethyl phthalate emulsion (5%); normal wash.	Minimum ..	2	Over 60						
	Maximum ..	2	Over 60						
	Mean ..	2	Over 60						
	Mites ..	27	30						
I. Two cloths: hand treated with dimethyl phthalate, one fluid ounce; normal wash.	Minimum ..	2	4						
	Maximum ..	2	Over 70						
	Mean ..	2	Over 50						
	Mites ..	41	50						
J. Two cloths: repetition of *I.*	Minimum ..		2	Over 50					
	Maximum ..		8	Over 50					
	Mean ..		2	Over 50					
	Mites ..		115	30					

TABLE VI.

Readings Made at Atherton in February and March, 1945, the Mites being Trombicula Minor. Cloths Treated with Dibutyl Phthalate by Hand or by Emulsion Dip as Described.

Treatments.	Type of Washing.	Stopping Times and Numbers of Mites.	Number of Washes.			
			0	1	2	3
One ounce, hand applied.	By hand; mild.	Minimum		9		
		Maximum		18		
		Mean		13		
		Mites		33		
One ounce, hand applied.	By hand; normal.	Minimum		12	11	13
		Maximum		16	16	22
		Mean		14	13	18
		Mites		23	70	24
One ounce, hand applied.	By hand; severe.	Minimum		9	12	11
		Maximum		16	20	18
		Mean		12	14	15
		Mites		46	78	91
One ounce, hand applied.	By scrubbing brush; normal.	Minimum		10	13	14
		Maximum		20	20	22
		Mean		14	15	16
		Mites		39	25	20
One ounce, hand applied.	By scrubbing brush; severe.	Minimum		14	9	11
		Maximum		19	28	24
		Mean		17	14	16
		Mites		43	71	78
One ounce, hand applied.	Laundered.	Minimum		10	14	20
		Maximum		24	37	Over 60
		Mean		15	21	Over 54
		Mites		64	49	17
Dipped in emulsion, 2·5% in 0·5% soap.	By hand; mild.	Minimum	6	14		12
		Maximum	10	17		20
		Mean	7	15		16
		Mites	41	26		81
Dipped in emulsion, 2·5% in 0·5% soap.	By hand; normal.	Minimum		9	8	12
		Maximum		17	19	19
		Mean		13	16	16
		Mites		27	24	60
Dipped in emulsion, 2·5% in 0·5% soap.	By hand; severe.	Minimum		9	12	9
		Maximum		20	25	28
		Mean		15	18	19
		Mites		78	68	78
Dipped in emulsion, 2·5% in 0·5% soap.	By scrubbing brush; normal.	Minimum		11	13	13
		Maximum		22	22	31
		Mean		15	17	17
		Mites		39	32	36
Dipped in emulsion, 2·5% in 0·5% soap.	By scrubbing brush; severe.	Minimum		16	11	16
		Maximum		20	24	38
		Mean		18	18	24
		Mites		20	61	55
Dipped in emulsion, 2·5% in 0·5% soap.	Laundered.	Minimum		10	Over 60	
		Maximum		21	Over 60	
		Mean		14	Over 60	
		Mites		66	40	

launderings. Emulsion-dipped cloth had shown suggestive lengthening of stopping times after three severe cold-water scrubbings and breakdown of protection after two launderings.

Rate of Administration.

Treatments corresponding to 0·5, 1·0, 1·5, 2·0, 3·0, 4·0, 5·0 and 10 fluid ounces per set of clothing were examined in cotton cloths, the mites being *Schöngastia pusilla* and *Schöngastia blestowei*. Indication of breakdown occurred as follows: (i) 0·5 ounce treatment—after six and eight washes; (ii) 1·0 ounce treatment—after six to sixteen washes in twenty-one tests (only in two tests (the first) did breakdown occur in less than eight washes; it was thought that faulty hand application, through inexperience, might have been a factor in early work); (iii) 1·0 to 5·0 ounce treatment—after eight to sixteen washes; (iv) ten ounce treatment—after 11, 11, 15 and 16 washes.

From these results it was concluded that increasing of the initial dosage beyond the one ounce rate could not be guaranteed to increase the residual dibutyl phthalate remaining in cotton cloth after washing.

Method of Application.

After some experience, test cloths were prepared as follows. The foot-square cloth, numbered, was folded twice, so that the outer surface consisted of one-half of the cloth with the numbered corner upwards. The hands were wetted with phthalate, and then wiped clean on another cloth. If, for example, an amount of 1·4 millilitres per square foot was decided on (corresponding to one fluid ounce per set of clothes), the hands were then smeared with 0·25 millilitre of phthalate, the folded cloth was picked up between them, and rubbed and patted to distribute the smear over the outer surfaces. The second fold of cloth was then turned back on itself, and treated with a second smear of 0·25 millilitre. This process was repeated, and finally two smears of 0·2 millilitre were applied to the surfaces in turn, so that in all 1·4 millilitres was smeared over one side of the foot-square cloth. The cloth was moved between the hands at each patting and rubbing. Finally, it was crumpled and rolled violently. Repeated testing of different parts of cloths so treated indicated an even distribution of the phthalates. Other methods tried included the following: (i) sprinkling the cloths from a shaker bottle with a temporary emulsion of phthalate and water; (ii) sprinkling or saturating the cloths with a stable factory-made mayonnaise emulsion, diluted as required; (iii) sprinkling or saturating the cloths with a solution of phthalate in alcohol. All these methods gave closely similar results, breakdown occurring

for *Schöngastia* after the eighth wash or later, with one or two exceptions for the cloths treated with one ounce hand-applied in the early stages.

The United States Typhus Commission has recommended the dipping of clothes in an emulsion of 5% dimethyl phthalate in 2% soap solution; this gives a cover equivalent to about two fluid ounces per set, treatment to be applied after each wash. Dibutyl phthalate emulsions were cloth-tested at Atherton as has been described above. At emulsions of 5% and 2·5% in 2% soap solution, the mixture formed what was considered an unnecessarily thick gel (differing in this respect from the dimethyl phthalate emulsion). A 2·5% dibutyl phthalate emulsion in 0·5% soap solution was considered adequately stable for camp dipping, and in cloth tests only slightly less resistant to washing than treatment with one ounce hand-applied (Tables V and VI).

Method of Drying.

Washed clothes were dried in the sun, in the shade, or artificially over lamps. No differences in stopping times were observed in tests taken up to seven washes.

Application to Inside or Outside of Garments.

In tests made on shirts, trousers and woollen serge test cloths, treated on one side only, similar stopping times were invariably obtained on treated and untreated surfaces when tests were made after one or more washes.

Application to New Cloth.

New cloth contains much "dressing", which is lost at the first wash. As it was feared that this material might take with it some of the phthalate, it was at first recommended that new clothes be washed before anti-mite treatment; this was often inconvenient. Subsequent testing by the cloth method indicated that new cloth held its toxic dose of dibutyl phthalate through seven wases as well as cloth washed before treatment.

Application to Water-Proofed Cloth.

A method of water-proofing clothes in the field, consisting in dipping the clothes in a 1:400 soap solution, drying them, dipping them in a 1:40 alum solution and drying them again, was tested for compatability with anti-mite treatment. Results with *Trombicula minor* indicated that: (i) the water-proofing treatment had in itself no miticidal properties, and (ii) that water-proofing, whether applied before or after dibutyl phthalate, had no observable influence on the miticidal properties of the phthalate and its resistance to washing.

Application to Different Kinds of Cotton Cloth.

There is considerable variation in the material from which Australian cotton shirts and trousers are made. The lightest and heaviest material of each was treated with amounts of one ounce and two ounces, and tested against *Schöngastia blestowei* after 8, 11, 14 and 15 washes. No significant differences appeared, breakdown occurring in all tests of the series after the fourteenth wash.

Application to Cloth Already Wet.

The effect of application to cloth already wet was examined, because troops may be issued with dibutyl phthalate in circumstances which make its immediate application necessary or desirable, though their clothes may be wet. The test cloth, treated wet with one ounce, gave no sign of breakdown for *Schöngastia blestowei* up to nine washes, when testing stopped. A minor disadvantage of treating wet clothes was found to be that the hand-applied phthalate did not "show up" as well as on dry cloth.

The Wetness of Cloth at Time of Test.

Cloths which had been treated while dry and wetted or damped before being tested usually gave shorter stopping times than did the same or corresponding cloths tested when dry.

The Effect of Sweat.

Clothing worn by troops on the march or engaged in other physical labour in New Guinea is usually completely saturated with human sweat for many hours in the day. The test cloths were saturated with human sweat between washings, and tested both while wet, after being rolled up and left damp overnight, and when clean after being washed. No differences of stopping times were observed to the seventh wash.

Storage after Treatment.

It is customary for forward troops, when going into action, to leave in storage a clean set of clothes, into which they change at the earliest opportunity on being relieved. Cotton cloths treated with dibutyl phthalate were tested up to ninety days, and remained fully toxic to *Schöngastia blestowei*. Later, tests of woollen cloths treated in New Guinea, when tested after seven months against *Trombicula minor* in Queensland, revealed stopping times closely similar to those of freshly treated cloth (seven to nineteen minutes, with a mean of thirteen minutes for 186 mites).

Attempts to Increase Resistance to Washing.

The recommendation of fortnightly treatments was made because cloth treated with one ounce had shown breakdown of resistance at six, seven or eight washes. Later, it was found in tests with *Schöngastia blestowei* that breakdown could more normally be expected after ten to thirteen washes. It was thought that this did not justify a departure from fortnightly clothing treatment, but offered some hope that, by special modification, a postponement of breakdown until after the fourteenth wash (monthly treatment being allowed) might be guaranteed. Modifications examined (but in a comparatively short series of tests) were: (i) the use of excessive amounts (ten ounces); (ii) storage after heavy treatment for one week before washing; (iii) boiling in clean water after treatment before washing; (iv) autoclaving for twenty minutes at fifteen pounds' pressure after treatment. Tests on all cloths treated in these ways showed breakdown between the tenth and sixteenth washes, and indicated no valuable result from the change from the normal one ounce dosage. Later, in Queensland, the ironing of treated cloth before the first wash produced in tests against *Trombicula minor* results similar to those from normal treatment.

Differences between Cotton and Wool.

When cloth tests were first run to find whether wool differed from cotton in its power to retain dibutyl phthalate after being washed, the results indicated that wool lost toxicity more rapidly than cotton. Woollen serge cloth (used because mites could not be controlled on knitted material like socks) treated with one ounce showed breakdown of protection against *Schöngastia* after four to seven washes and occasionally even after the third wash. When two ounces were used, the breakdown did not occur before the fifth wash. Although no corresponding early loss of protective power by treated socks had appeared in field tests, it was thought advisable to provide for a higher dosage of fluid for socks than for other clothing. The instructions issued (see Appendix) therefore provided that each sock be given six smears, representing an application at a rate nearer to two fluid ounces than one per twenty square feet. The supplementary use of dimethyl phthalate was also recommended for certain conditions.

The differences between cotton and wool have not been quite clarified. In the earliest tests, wool was washed as cotton with vigorous rubbing. Later, this gave way to squeezing only, which is correct for wool, as rubbing causes felting. Correctly washed wool subsequently showed retention of dibutyl phthalate at least as good as that for vigorously rubbed cotton.

Different Forms of Dibutyl Phthalate.

In July, 1944, it became necessary to evaluate "secondary" dibutyl phthalate, as distinct from the normal "primary" compound used in all work done up till then. Cloths were treated with the two fluids in amounts of one ounce, and sent to Major A. R. Woodhill, then at Lae. He

tested the two series against *Schöngastia blestowei* until after the fifth wash, reporting only insignificant differences in stopping times between the two.

Species Variation in Susceptibility to Dibutyl Phthalate.

In New Guinea, *Schöngastia pusilla* and *Schöngastia blestowei* were used in cloth tests, because they alone could be found with certainty in sufficient numbers. Of other species encountered from time to time with them, *Schöngastia parva* (Womersley MS.) *Trombicula minor*, *Trombicula fletcheri* and *Trombicula hatorii* gave approximately similar stopping times; but *Guntherana bipygalis*, *Guntherana parana* and *Acomatacarus novaguinea* usually moved for about twice as long.

The field test at Dobodura, where volunteers were protected by dibutyl phthalate, exposed the men to mixed populations, in which *Schöngastia pusilla* predominated, and in which probably too few specimens of the more resistant forms were present to make biting obvious. The possibility that troops may encounter large populations of resistant species of mites and so need increased frequency of clothing treatment has been borne in mind; but to date this does not appear to have occurred.

In Queensland, *Trombicula minor* gave normal stopping times on freshly treated cloth; but breakdown occurred consistently after the fifth or sixth and occasionally after the fourth wash—a very different picture from that presented by *Schöngastia* in New Guinea. This result could have been due either to a sudden increase in severity of laboratory washing, against which precautions were considered to have been taken, or to greater resistance to low concentrations of phthalate on the part of *Trombicula minor*. Whether this breakdown of protection might lead to failure of the fortnightly treatment programme could have been determined only by field tests, which were not undertaken. There was no evidence that routine treatment failed in practice; but it is to be noted that troops in the relatively cool Atherton Tableland area rarely washed their clothes more than four times in a fortnight.

At least one North Queensland species, *Acomatacarus athertonensis* (Womersley, 1945), is strikingly resistant, having the following stopping times on cloth treated with one ounce per 20 square feet: (i) unwashed: minimum, 13 minutes; maximum, 66 minutes; mean, 25 minutes, in 62 tests; (ii) washed three times: minimum, 23 minutes; maximum, 56 minutes; mean, 38 minutes, in 28 tests. Two men, wearing clothes washed not more than three times since treatment, were exposed frequently to large numbers of this species, and were not bitten. Its importance is doubtful, because it occurs commonly in country where neither scrub itch nor scrub typhus has been recorded.

Other Miticides.

Dimethyl phthalate was not fully examined. On treated, unwashed cloth it is much more rapidly toxic to mites than is dibutyl phthalate. In the earliest cloth and field tests at the rate of one ounce per 20 square feet, initial breakdown of protection occurred after the third cold water wash. American workers then proved that dimethyl phthalate emulsion could be removed by one wash. At Atherton, as shown in Table V, tests of cloth treated with dimethyl phthalate in emulsion showed breakdown after one wash, while those of cloth hand-treated with amounts of one ounce showed breakdown after one or two laboratory washes. This necessitated the withdrawal of earlier instructions that dimethyl phthalate, if used for mites when dibutyl phthalate was unavailable, should be applied after alternate washes or at weekly intervals.

DDT was not subjected to detailed cloth tests, because it was considered to have failed in field tests. On cloth treated with it at the rate of ten and twenty grammes per set of clothes, however, some specimens of *Schöngastia pusilla* were still moving with considerable freedom after forty-five minutes on unwashed cloth, and after 120 minutes on cloth washed twice. DDT is a slowly acting poison to many insects. That it is so to Trombiculid mites was taken as an explanation of its failure to give complete protection in the field.

Early in October, 1943, at the request of Major C. E. Ahlm, of the United States Forces, cloth tests were carried out on "Staway" and Rutgers "612" mosquito repellents. The cloths were treated at the rate of one fluid ounce per twenty square feet, and tested over several days against *Schöngastia pusilla*. Recorded stopping times are set out in Table VII.

TABLE VII.

Repellent.	Day.	Cloth Unwashed.	Cloth Washed Once.
"Staway" ..	First. Second. Third. Fourth.	12 mites, 1 to 2 minutes. 8 mites, 1 minute. 3, 3, 4, 4. 13, 12, 18, 25, 25.	Over 65, over 120.
"612" ..	First. Second. Third. Fourth.	8 mites, all 5 minutes. 4, 5, 5. 4, 4, 4, 4. 5, 7.	Over 65, over 120.

For clothes expected to be washed every day or two in mite-infested country, it was considered that both "Staway" and "612" would give protection, but only if applied after each wash.

Benzyl benzoate was stated in confidential reports by United States workers to be an outstanding miticide for clothing treatment. No sample was available to the writer until the move to Borneo had begun. In Borneo cloth testing proved impracticable.

Methods of Clothing Treatment.

The method eventually adopted for use by Australian troops was complete treatment of socks, trousers and shirt with one fluid ounce of dibutyl phthalate rubbed into the clothing by hand (Figures VII to IX), application to be repeated at intervals of two weeks without restriction on cold-water washing. Before this recommendation was made, however, several alternative methods had been examined and discarded.

Spraying.

Shaker bottles, made by punching the finest practicable holes (0·01 inch diameter) in the metal caps of screw-top bottles, were used to distribute pure fluid, or preferably a 1:4 mixture of fluid in water, which was maintained in temporary emulsion by the shaking. With the temporary emulsion these bottles gave good protection, and were used in field tests; but they were not recommended for general use because of unwillingness to add another article to the burden of the jungle soldier.

Sprinkling with permanently emulsified phthalate was considered. A factory-made, concentrated (50%) emulsion of dibutyl phthalate was not adversely affected by six months' storage in New Guinea, yielded a stable emulsion at all required dilutions, and gave the same toxicity figures as did the pure fluid, hand-applied. Shaker bottle and more crude sprinkling methods of applying this emulsion were tested, but were considered inferior to dipping.

Mechanical sprayers in various forms were tested.

Atomizers. Among atomizers were mouth-operated blowers, small sprayers for use by hand (simple household atomizers), continuous hand disinfectors (larger household atomizers), and a compressor-driven paint gun. Various nozzle sizes and combinations were tried, but atomizers were considered unsatisfactory because of the generally slow rate of delivery (400 strokes of a small household sprayer to deliver one fluid ounce), and the large proportion of the fluid in excessively fine droplets which did not penetrate the cloth and was objectionable to operators. Subsequent field experience has shown that, when atomizers were used in spite of warnings to the contrary, such treatment of clothing did not prevent scrub itch. Their use for this purpose has therefore been forbidden.

Sprayers other than atomizers consisted of bottle sprayers (as used by barbers), hand pneumatic sprayers, stirrup pumps and knapsack sprayers, again with various

FIGURE VII.
Treatment of clothing (*a*); the finger tips are dipped in the tin of fluid. (Photograph Military History Section.)

FIGURE VIII.
Treatment of clothing (*b*); the socks are rubbed vigorously between the smeared hands. (Photograph Military History Section.)

FIGURE IX.
Treatment of clothing (*c*); the smeared hands are wiped over the clothing spread on a flat surface. (Photograph Military History Section.)

nozzle modifications. These generally delivered liquid too fast for the economical treatment of clothing with dibutyl phthalate. With the smallest practicable nozzle (0·02 inch diameter) and a stirrup pump, it was difficult to treat a set of clothes with less than two fluid ounces.

Dipping.

Dipping was not extensively tested, because of the emphasis on need for protection against mites in the most forward situations where suitable drums were often extremely scarce. When men had only one set of clothes each, and almost all washing was done in streams, communal dips would present special difficulties considered to outweigh their advantages (completeness of cover and speed of treatment of the individual garment). In the wet New Guinea jungles a treatment that left the clothes dry was much to be preferred.

With the adoption of dipping by the United States forces a change to that method for Australian troops was from time to time considered, with the proposal to issue dibutyl phthalate with an emulsifier added to it. The decision on each occasion was that while the apparent results of hand-treatment continued to be excellent, no change should be attempted.

Hand Application.

Hand application, at first tested and recommended with hesitation as a stop-gap pending the development of some wholesale method, was systematized and came to be regarded as practicable and much superior to any other.

The dosage rate decided on was one fluid ounce per set of clothes to be applied fortnightly, and the scale of issue was three fluid ounces per man per fortnight, since the basic ration of clothes was three sets per man. (In base areas men had three sets, in the front line one set, and in intermediate situations two sets.) Experiments had indicated that a dosage rate of 0·75 fluid ounce applied with great care would give protection, and that an increase beyond one fluid ounce was uneconomical. The reason for fortnightly treatment was that when a man had two sets of clothes he might wash each seven times in a fortnight—he would not do more. When he had only one set, as on patrol, he would certainly be unable to wash them as often as seven times in two weeks. It was estimated that fortnightly treatment would mean a maximum of seven washes, and when protection was most needed usually not more than three washes, between applications. The scale of issue of three ounces per man per fortnight was maintained in forward areas to allow for wastage in distribution and to allow units and sub-units to accumulate small working reserves.

The only important disadvantage of hand-treatment was considered to be its tediousness, and the doubt whether every man in a force could be trained to use the fluid properly, even under supervision. Against this doubt was the knowledge that the operation was in fact little more complicated than cleaning boots, that soldiers are successfully trained in numerous operations many times more difficult, and that troops really fear scrub typhus.

Considered to be overwhelming advantages of hand-treatment were the following: (i) the lack of special equipment; each man needs only a tin, such as a tobacco tin, or if that is not available, his drinking mug; (ii) the fact that the method employs the full manpower of a force.

It takes about fifteen minutes to treat a set of clothes, though experienced men can do it in a considerably shorter time. In practice, any body of troops can treat all their clothes at one short parade. For the majority of alternatives to individual hand-treatment, one must contemplate treatment stations or treatment squads. Such arrangements involve either the taking of the clothes from the men and the responsibility of their return, known to be difficult in the field, or the waiting in queues for a turn of spraying, dipping *et cetera*.

APPLICATION OF PHTHALATES IN THE FIELD.

Absence of Objectionable Features.

Dimethyl phthalate was pronounced harmless in patch tests by Lieutenant-Colonel A. Dawson, consulting dermatologist (McCulloch and Waterhouse, 1946), before being recommended as a mosquito repellent. Long experience of its application twice a day to the skin of face and hands by many thousands of troops has resulted in no known cases of injury. It is known, however, to

cause severe, temporary stinging if applied directly to the skin of the scrotum, and mild or moderate stinging in the same area when used in complete clothing treatment.

Dibutyl phthalate appears to be less irritant, treated clothes having been worn by some units (many men sleeping in their clothes) for more than six months without complaint. Occasionally cases of dermatitis have coincided with the issue of anti-mite fluid, but have soon been proved to be unconnected with it. However, more than a year after anti-mite fluid came into general use, an accident occurred, as a result of which it seems certain that even a small quantity of dibutyl phthalate in the eye can cause grave injury.

It seemed, in some instances, that the use of anti-mite fluid accelerated the shrinking of woollen socks. Yet there were many examples of socks wearing satisfactorily for six months, though constantly treated. Probably the resistance of socks to the extremely severe conditions prevailing in forward areas varied considerably.

Freshly treated clothes have an appearance of patchy greasiness, hardly obvious if fluid is applied carefully to the inside of the garments. This patchiness disappears after washing, and treated clothes usually cannot be distinguished from untreated clothes.

Supply and Distribution.

When dibutyl phthalate was adopted as a miticide, it was given the distinguishing name of "anti-mite fluid". For many months it reached forward areas packed in five-gallon drums, the only type then available. Objections to the large containers were to some extent overcome by dispensing the fluid to the troops by measured ladles, but distribution in forward units was much more difficult than if it had been packed in smaller tins. Later, one-gallon tins became the standard pack. Pint tins would have been a further improvement, but have not been available. It was never considered necessary, as in the case of mosquito repellent which is used daily, that men should carry their own individual supplies.

Since scrub typhus in New Guinea is a disease notably associated with the occupation of new country, and its incidence among forward troops has always greatly exceeded that in base units, supplies of anti-mite fluid were allocated first to selected and later to all operational areas. There remains the question whether full anti-mite precautions are warranted in established bases. Ideally all troops in endemic areas should be protected. If this is not practicable, all troops should certainly wear treated clothing during the initial developmental period; thereafter men required to work in undeveloped localities, even when these are only uncleared patches within the base area itself, should treat their clothes.

Instruction of Troops and Intraunit Organization.

It was realized that the adoption of hand treatment necessitated the organization of a special campaign for the instruction of troops. The use of the fluid was made a unit responsibility, treatment to be done on parade and under the supervision of officers and non-commissioned officers. Orders were promulgated, and detailed printed instructions (see Appendix) were issued eventually to nearly every officer and non-commissioned officer.

In addition, lecture-demonstrations were arranged, at which the method of clothing treatment was shown and mite habits were discussed. When the fluid was first made available, the writer visited some forty battalions, lecturing to representative groups (approximately 10% of strength). Each man attending was to become an instructor in his section. The impression was formed that officers and men, at first incredulous that hand smearing could be superior to some method involving dipping or spraying, and perhaps showing irritation at a new addition to the duties imposed by preventive medicine in jungle warfare, could readily be convinced of the advantages of the procedure ordered. The questions asked and the information given the demonstrator concerning varying conditions under which the fluid had to be employed proved of great value in indicating problems to be attacked in the laboratory.

Later, schools were organized at which medical officers and hygiene personnel took short, intensive courses. Whenever possible, the men were taken into the field in treated clothing to observe mites on the ground, on boots and especially on treated cloth.

In the field it came to be regarded as essential that non-commissioned officers at every quartermaster's store of a unit or subunit should be in charge of anti-mite fluid. His duty was to see, not only that supplies were distributed at the intervals prescribed, but that men requiring treatment between regular issues received fluid and instruction in its use. Fortnightly treatment was in general adhered to even for troops in action, but in some instances when washing of clothes was infrequent, retreatment was justifiably postponed until rest periods, the interval rarely exceeding three weeks.

Because of their fear of typhus, men receiving adequate instruction in forward endemic areas made few serious errors in clothing treatment, but they became careless in training areas where the risk was relatively small. Some imperfections of organization for training or distribution observed were as follows.

1. The receipt by units of supplies of anti-mite fluid and orders for its use were not sufficient to ensure efficient distribution and application. Demonstrations by experienced instructors able to answer questions as to how practical difficulties had been overcome were clearly invaluable. While such demonstrations were arranged before moves to danger areas for front-line troops, this was not always done for various specialist and base units.

2. Ideally, units preparing for embarkation to endemic areas would have employed regular fortnightly treatments of all the men's clothing in training. This would have provided necessary experience, especially for unit quartermaster services, and would have been a guarantee against embarkation in untreated clothes. However, it was generally not possible, because of inadequate supplies of the fluid—at first of total supplies, and later of supplies for training in at least one important area. Occasional treatment parades before special exercises provided a less satisfactory substitute. Some units did move from Queensland in 1945 into new camp sites on Morotai in untreated clothes, their experience showing the country in question to be free from infestation.

3. In the later stages of the war many reinforcements were still arriving in endemic areas quite ignorant of scrub typhus control.

Nevertheless the campaign to instruct troops in the novel method of disease control was broadly successful. A great reduction in the incidence of scrub typhus followed it, and when cases did occur, failure in supply was found to have been a much more important factor than misuse of the fluid by the individual soldier.

Special Treatment of Socks and Underclothing.

In the Ramu campaign, occasional reports were received that limited biting had occurred on the ankles of some men during the second week after regular clothing treatment. This was generally attributed by men in the field to the rinsing of phthalate from socks by water, since lines of communication frequently were along mountain creek beds involving wading knee deep in streams many times in a day. Later cloth tests made it seem extremely unlikely that wading was causing the alleged breakdown in protection, which was thought more likely to be due either to inefficient (patchy) application or to actual failure of treated wool to give protection for more than three or four washes. For either explanation, the remedy recommended was the retreatment of socks after the first week with the dimethyl phthalate carried by each man as a mosquito repellent.

Relatively few men wore underclothes. It was recommended that both outer and undergarments be wholly treated to guard against the risk of one being worn without the other. While the scale of issue did not specifically provide for underclothes, it was found that small excess unit stocks usually made practicable the issue of slightly more than the regulation dose to those men requiring it.

Protection of the Head.

Attachment of Trombiculid larvæ except under clothing has been rare, but occasional bites and eschars have occurred on the head. Because of the normal activity of troops and susceptibility of mokkas to desiccation, such biting is much more likely at night than by day, and the best practicable defence against it is considered to be routine and thorough use of dimethyl phthalate for malaria control. It would protect the skin for some hours (probably for a longer period in the hair), and play an important part by impregnating the hat band and articles used as pillows.

Treatment of Blankets.

Anti-mite treatment of blankets was adopted when supplies made it possible, and was in force for almost all forward troops after October, 1944. No attempt was made to assess the additional protection afforded by treated blankets to troops wearing fully treated clothing; but the small outlay in material and labour (six-monthly application would certainly provide blankets fully toxic to mites) was considered to be more than worth while. For reasons of mobility, economy and lack of equipment discussed previously, hand application was recommended when it was found that a man experienced in clothing treatment could treat a blanket efficiently in ten minutes using 1·5 fluid ounces of fluid. In many formations going abroad, men treated their one blanket before embarkation. In others, blankets were issued after being dipped at army laundries in emulsions prepared according to the method of the United States Typhus Commission.

Results of Clothing Treatment.

The exposure of large bodies of troops to jungle conditions in North Queensland and New Guinea showed that, while scrub itch and scrub typhus were sometimes encountered together, scrub itch could be common or almost universal in a force reporting no cases of scrub typhus, and that outbreaks of the disease could occur without reported itch. As the present studies progressed, it was shown by other workers that mites proved to be responsible for itch (*Trombicula minor*, *Schöngastia blestowei*, *Schöngastia pusilla*) probably do not carry the disease, while it was realized that the proved vectors occur (or seek to attack man) in such small numbers as to make most difficult direct studies of the effect of phthalate treatment on them. It was learned further that Trombiculids vary in their susceptibility to dibutyl phthalate in cloth (for example, the relative resistance of *Acomatacarus athertonensis*), so that it became necessary to study the effect of clothing treatment under two heads, (*a*) scrub itch and (*b*) scrub typhus.

The Effect on Scrub Itch.

The labels of the first bottles of dimethyl phthalate issued as mosquito repellent carried advice that it could also be used for protection against mites. Its general use for this purpose was not encouraged, however, because supplies for long were barely sufficient to provide a full scale of issue for protection against mosquitoes. In certain areas, where the incidence of typhus became relatively heavy and dibutyl phthalate was not on issue, the use of dimethyl phthalate was ordered. These were base areas, where it was considered that men were free from mite attack at night, and not required to sit or lie on ground during the daytime. Accordingly, the method ordered was hand-treatment of socks and trouser bottoms, at first after each washing and later once a week.

No systematic check of results was attempted. Units invariably reported a considerable reduction in scrub itch, which this limited treatment could not be expected to prevent entirely. Many men more or less in constant touch with mite-control work (personnel of malaria control units and the hygiene service) have also used sock and trouser leg treatment with mosquito repellent over many months, and reported complete freedom from itch, though their work frequently took them into mite-infested country.

Similarly with dibutyl phthalate. The writer, clearly susceptible to the bites of *Acomatacarus australiensis* in Sydney and of *Trombicula samboni* in South Australia, has not, so far as he knows, been bitten in Queensland, New Guinea or Borneo. From November, 1943, he wore clothing treated once a fortnight at the rate of one fluid ounce with dibutyl phthalate (usually three sets were worn on alternate days and therefore washed four or five times per fortnight). The work involved cloth-testing for many hours daily for many months in the most dense patches of mites obtainable, or boot collecting in mite surveys in which altogether very large numbers of mites must have escaped under the gaiters. In this time more than twelve other men have taken part in cloth-testing for periods in excess of ten days, while three have been regular participants in mite surveys. All wore fortnightly treated clothes. If they experienced bites, the latter were so few as to pass unnoticed.

Units in infested country in Queensland and New Guinea, on adopting full anti-mite treatment, all reported excellent control of scrub itch.

Statistics of Scrub Typhus.

Anti-mite fluid was first issued to any substantial part of the Australian forces in New Guinea at the end of November, 1943. The division in the Ramu Valley and Finnesterre Range received it then and was continuously supplied until the troops were withdrawn to typhus-free country. The fluid was made available at Finschhafen late in January, 1944, but withdrawn because of scarcity after six weeks. Stocks were adequate for all forward troops from June, 1944, including the formations which fought the Aitape-Wewak and Solomon Islands campaigns, which began in November, 1944.

Figure X shows the incidence of scrub typhus in Australian troops in the New Guinea area of operations from the first notifications in October, 1942, to December, 1945, expressed as cases notified per 100,000 men per four weeks.

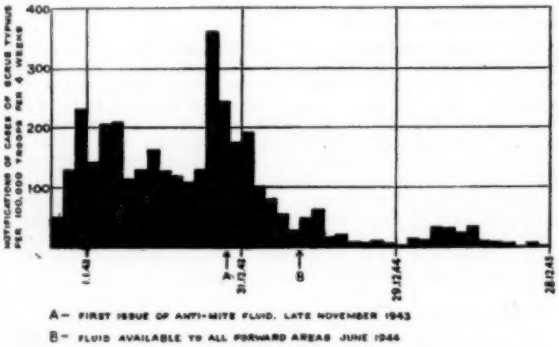

FIGURE X.

Graph showing incidence of scrub typhus in the Australian army, New Guinea area of operations, 1942 to 1945.

The records from which the graph is prepared have certain defects. (i) The time between infection and notification varied. It was usually about five weeks, but was occasionally as short as three or as long as ten weeks. (ii) Some cases of other diseases such a dengue were probably notified as scrub typhus. The most important reasons for this were absence of agglutination tests in some of the earliest cases and clerical errors in which "probable" cases from field ambulances, having failed to be confirmed in hospitals, were left on headquarters lists. The number was never important in its influence on figures as a whole, and in the detailed studies of the Ramu Valley records such errors were avoided.

The decline in scrub typhus after the issue of anti-mite fluid is striking. For the last year of the war the mean rate was about 9% of the mean rate for 1943, and this in spite of the fact that more troops than ever before were exposed to patrol conditions. The decline alone, however, does not prove the treatment to have been effective. It was

known that intraunit distribution and individual application of the fluid were not infrequently less than perfect. The decline could have been due to the movement of the fighting into generally less heavily infested country. Against this it is known that no forward area was typhus-free (as, for example, West Borneo appears to have been); Japanese and American records and Australian cases show all areas to have had some endemic foci. But before the over-all figures are discussed further, it is desirable to examine the histories of a force where more detailed information was gathered.

Ramu Valley.

All units of the division in contact with the enemy in the Ramu Valley area received anti-mite fluid at the end of November, 1943. The records of the battalions of the four infantry brigades concerned are available for study.

Brigades A and B advanced from Lae and Nadzab in September, 1943, reaching Dumpu in the Ramu Valley by mid-October. They remained there until the end of December, one brigade at a time being stationed in the hills to the north of the valley in contact with the enemy, and the other occupying camps in the main valley, where the men rested or were engaged in the construction of defensive positions, roads *et cetera*. These brigades changed places at intervals of three weeks. The brigade area in the valley was three or four miles long and about one mile wide, mainly grassed rather than timbered, and fairly uniformly infested by mokkas. Old camp sites were sometimes occupied by incoming units at change-over, while at other times new sites were developed. In the oldest sites, mites were found in November, December and January in untrampled patches of grass—for example, close to the walls of huts and tents. After a quiet period, there was an increase in patrol activity by some units in the valley positions in mid-December.

Brigades A and B were relieved by Brigades C and D on approximately January 1, 1944. Brigade C marched from aircraft in the main valley to make contact with the enemy in the hills, where they attacked and were on the offensive for seven weeks, being then relieved by Brigade D. During the offensive, units and subunits had rest periods behind the front line. Brigade C returned to the main valley in the third week of February and remained there until withdrawn in mid-April.

Brigade D marched from aircraft to valley camps. Within a few days some units went on patrol on the left flank of Brigade C. The equivalent of about half the brigade remained in the main valley. After relieving Brigade C in the third week of February, Brigade D forced the enemy through the ranges to the coast in the vicinity of Bogadjim. Two battalions marched north to the Madang area, and one remained near Saidor. Semi-permanent camps were occupied in May, after which patrolling was limited until the brigade sailed in July.

Anti-mite fluid was available for Brigades A and B from the end of November, demonstrations being provided for representatives of all units. Units of Brigade C, arriving with untreated clothing, received supplies and printed instructions almost immediately; subunits were given demonstrations during the following ten days, but in some cases they received no fluid for two or three weeks. Intra-unit distribution of the fluid was improved before the return to the main valley in February, because the occurrence of cases had drawn attention to its need, while the fact that battalions were by then resting in turn after action had made it less difficult. Units of Brigade D also arrived in untreated clothes; supplies and demonstrations were given to fully representative groups on the first day, and full treatment was organized by the second day.

The scrub typhus rates of the four brigades, with relevant notes, are shown in Table VIII. They are based on dates of onset of disease or of evacuation from unit regarded as occurring two weeks after infection (not on notification, with its greater and much more variable time lag). In approximately one-quarter of the cases recorded for December the men could, by an incubation period of more than two weeks, have been infected before the issue of the fluid. For convenience and clarity, the scale of cases per 10,000 men per week is adopted in these brigade records.

Discussion.—The results show the following reductions in the incidence of scrub typhus after the introduction of anti-mite fluid: (i) for Brigades A and B an immediate fall to 41% and 29% respectively of the previously existing rate; (ii) for Brigade C no reduction during the first seven weeks (as compared with previous figures for Brigades A and B), but a fall to 10% for the following ten weeks; (iii) for Brigade D a fall to 10%. The majority of men infected after issue of the fluid were questioned individually in hospital, after it had been explained to them that on the truth of their statements lay the main hope of discovering whether this new method of disease control was in fact worth while. Of the fourteen men in Brigades A and B certainly infected during December, seven were questioned, and of these six had used no anti-mite fluid. Of 51 men in Brigade C evacuated in the first eight weeks (36 must have been infected in the first three weeks), 42 were interviewed, and of these 33 had used no fluid or clearly inadequate amounts; one had used the fluid wrongly; four were doubtful—the men had worn untreated clothes for short times (for example, overnight) at the critical period; four had had adequate supplies and used the fluid as directed. Similarly in Brigade D, of the ten patients evacuated in the first thirteen weeks, six had worn untreated clothes at the time of infection.

Thus, after the issue of the fluid there was a sharp decline in scrub typhus, and of the cases which did occur, the great majority were not due to failure of treated clothing to give protection. The very small number of true failures indicated a potential reduction of more than 95%. It is still necessary, however, to examine other possible explanations of the observed decline.

The apparent success of the treatment in Brigade D for the period January and February and in Brigade C for the period from February to April could have been the result of an almost complete freedom from infestation of the main valley as opposed to the neighbouring hill positions (Cook, 1944). That the valley in fact initially had a relatively high rate of infestation equal to that of

TABLE VIII.

Brigade.	Fluid Available.	Nature of Duty.	Period.	Time in Weeks.	Rate of Scrub Typhus per 10,000 per Week.
A	No.	Patrolling.	September and October.	6	42
B	No.	Patrolling.	September and October.	6	52
A	No.	Movement limited.	October and November.	6	27
B	No.	Movement limited.	October and November.	6	34
A	Yes.	Movement limited.	December.	4½	11
B	Yes.	Movement limited.	December.	4½	10
C	Yes.	Patrolling.	January and February.	7	30
D	Yes.	Patrolling.	January to March.	13	3
C	Yes.	Movement limited.	February to April.	10	3
D	Yes.	Patrolling, five weeks Movement limited, 10 weeks	April to July.	15	2

the hills is shown by the records from Brigades A and B for the six weeks before the use of anti-mite fluid could have had any effect. These formations were then alternating between valley and hills, and their weekly evacuations to hospital remained relatively constant and similar (Table IX).

The reduction in scrub typhus after the use of anti-mite fluid could possibly have been due to decline in the rate of infestation of the areas occupied. This would have involved a decline in infestation rate in December for the Ramu Valley, and a decline in December, a rise in January and a sharp fall in February for the hills to the north. The only known cause of such declines elsewhere has been stabilization of camps. This could not have applied in the examples quoted, because units frequently occupied new sites in their brigade areas and few camps approached permanent base conditions. Moreover, there was continual intraunit movement for the making of roads, defensive positions *et cetera* in virgin country, various bodies of troops being exposed to conditions which have been associated elsewhere with typhus outbreaks.

Finally, it could be postulated that Brigades C and D in the Ramu Valley, and Brigade D on its march from the Finnisterres and Madang, consistently avoided nearly all foci of infestation. This seems incredible, for Brigades C and D worked in the same area and performed the same duties as Brigades A and B before treatment. The cases which did occur in formations with treated clothes show that some infestation was encountered throughout the period and in widely separated localities.

There is, then, hardly room for doubt that anti-mite fluid rather than changing circumstances controlled scrub typhus in the brigades discussed, and did so in proportion to the efficiency with which it was distributed and used. It is considered most significant that Brigade D, with excellent organization for the instruction of troops and distribution of the fluid, and with its low case rate from the beginning of exposure to risk, was already famous for its control of malaria, while the decline in infection in Brigade C was clearly associated with a considerable improvement in anti-mite discipline, stimulated by reports through the hygiene services of the number of patients admitted to hospital after the first fortnight of exposure to risk.

Later Outbreaks.

After the Ramu campaign scrub typhus cases were sporadic (some occurring in base units not employing anti-mite fluid), with the exception of two outbreaks. The rise on the graph for June and July, 1944, was mainly due to cases from the coast north-west of Alexishafen, and that for March to June, 1945, to an outbreak in the Aitape-Wewak sector. They were not investigated so thoroughly as were the cases from the Ramu Valley brigades. However, medical authorities reported that again there had been little or no sign of failure of protection by efficiently treated clothing.

In the first incident one brigade was concerned. Its typhus cases (per 10,000 men per week) were as follows: June, 25; July, 22; August, 3; September, 0; October, 0; November, 0. Throughout the period the duties performed remained essentially unchanged—patrol activity in the one area.

Medical reports leave no doubt that while anti-mite fluid was on issue in May and June, the distribution and application were relatively inefficient, and that after the diagnosis in the first cases was confirmed, an educational campaign altered the standard of anti-mite discipline, which became good.

In the second rise in incidence rate, the Aitape-Wewak sector contributed 67 cases for the period from March to June, 1945, as compared with 17 from the remainder of New Guinea, New Britain and the Solomon Islands. Major G. Read, in reporting on the outbreak, showed that of 22 patients questioned, 16 had departed from instructions in some important degree. He showed that the force, beginning its offensive from within a perimeter known (through American experience) to include endemic foci, had had no cases for two months, an over-all rate of less than two per 10,000 per week for eight months, and a maximum and exceptional rate of nine per 10,000 for one week (which may be compared with the mean weekly rates of 27 to 52 for twelve weeks in two brigades in the Ramu Valley before the use of anti-mite fluid). Major Read concluded:

> It is considered that the casualties from this disease would have been much greater in the absence of this repellent (dibutyl phthalate) and if it had not been properly used in the majority of instances.

Evidence from Bat Island.—That efficiently used phthalate treatment of clothing can give protection against scrub typhus is indicated by the history of Bat Island, a 42 acre atoll in the Purdy Group north of Madang. It was abandoned in May, 1944, by a small combined force after 27 men of 46 had been infected with scrub typhus in 46 days. Lieutenant-Colonel C. B. Philip and Major G. M. Kohls, of the United States Typhus Commission, with two other men, spent four days on the island in June, 1944, recovering strains of *Rickettsia orientalis* from mites (*Trombicula deliensis*) taken from rats. The party wore clothing treated with dimethyl phthalate, experienced no mite bites, and escaped scrub typhus infection (Philip and Kohls, 1945). A Royal Australian Air Force research unit comprising twelve men lived on Bat Island for 119 days from July to November, 1945, camping on the site occupied by the combined force in 1944, exploring the island and also recovering strains of *Rickettsia* from mites on rats. The earth of tent floors and immediate surroundings was sterilized with creosote; outside the sterilized area the protection depended on was clothing treatment. This procedure differed somewhat from normal Australian army routine, in that long leather boots impregnated with dimethyl phthalate were normally worn and the clothing was treated by being dipped in 5% emulsion of dimethyl phthalate for the first week and of dibutyl phthalate (once a fortnight) subsequently. All personnel escaped infection (Squadron Leader J. Gunther, personal communication).

Conclusion.

Since 1943 experience has shown that under the conditions experienced by Australian troops in New Guinea, efficient fortnightly applications of dibutyl phthalate at a rate of one fluid ounce per set of clothes controls scrub itch. That the routine procedure laid down for troops under field conditions did so is also agreed.[1]

[1] This is the more credible when consideration is given to the poverty of their facilities for the washing of clothing. After a month in a forward area the average soldier would wear clothes treated three times and washed inefficiently probably less than four times, so that even in the event of patchy application, impregnation probably became thorough.

TABLE IX.

Scrub Typhus Evacuations for Brigades A and B.

Brigade.	Week Ending.						Totals.
	November 12.	November 19.	November 26.	December 3.	December 10.	December 17.	
Brigade A	8	4	3	5	5	7	32
Brigade B	4	7	12	6	6	6	41
Totals	12	11	15	11	11	13	73

Concurrently, any doubt concerning the importance of Trombiculine mites as vectors of scrub typhus has been removed. Cook's (1944) theory of a tick vector has received no support, while workers of the United States Typhus Commission (Kohls, Armbrust, Irons and Philip, 1945) have recovered many strains of *Rickettsia orientalis* from *Trombicula deliensis* and *Trombicula fletcheri* and made the following statement:

> We believe there is no likelihood that ticks or ectoparasites other than Trombiculid mites are concerned in the transmission of tsutsugamushi disease in any of the areas we have studied.

That thorough clothing treatment with phthalates gives protection against scrub typhus is strongly supported by the history of Bat Island.

For the New Guinea area as a whole, routine use of dibutyl phthalate by Australian army troops was followed by a reduction in scrub typhus of more than 90%. A similar reduction occurred in the Ramu area, where a more detailed study of unit histories showed an even more impressive correlation between the use of anti-mite fluid and the decline in the disease rate. On this evidence the following claims are made:

1. That the method employed of clothing treatment with dibutyl phthalate gave excellent control of scrub typhus under operational conditions.
2. That when the difficulties of introducing a new method of disease control to a large body of men are considered (in the light, for instance, of experience with "Atebrin" to suppress malaria), the results were better than might have been expected.
3. That where almost complete control was not achieved, the failure was chiefly due to errors of intraunit distribution of anti-mite fluid, and much less to failure of troops to use it as directed or failure of treated clothing to give protection or to causes not understood.

Scrub Typhus in Borneo.

Australian troops invading Borneo did so with clothing (worn and unworn) treated with anti-mite fluid, and supplies for retreatment were abundant and accessible. Weaknesses in management of the fluid and in anti-mite discipline were in some cases exposed in the move from Queensland to Morotai and were probably corrected in the period of stay there.

No scrub typhus was reported from Tarakan or British North Borneo, which in the absence of civilian records of the disease may be regarded like Morotai as free from infestation in the areas occupied.

At Balikpapan some twenty cases of scrub typhus were notified. The majority were described by physicians as atypical; the symptoms were mild and OXK agglutinations were at one in eighty. But in four cases agglutination was as high as one in 1,280, and of these one case proved fatal. The majority of the men concerned were in one brigade and were infected during July, 1945. The majority also had used anti-mite fluid as directed; a number had not been able to retreat their clothes for three or four weeks, but had not washed them more than once or twice in that time. The infestation was confined to neglected plantation country on the coastal strip between the outskirts of Balikpapan and a point slightly beyond Mangar Besar to the north. Throughout this country it was possible to collect on boots, in the abandoned bivouac sites examined, very small numbers of *Trombicula wichmanni* (one to twenty mites were taken in a day by two or three men). No other Trombiculid mites were found.

When the diagnoses were made, hostilities had ceased, troops were withdrawing into oase camps, and the future of Australian Army Medical Corps units was uncertain. Investigation of scrub typhus in the area was abandoned.

Camp Site Selection and Locality Disinfestation.

The avoidance of scrub itch by the selection of sites for rest, bivouac or camp was to some extent practicable in Queensland, where infestation occurred typically at the edge of the jungle and in some other restricted situations. In New Guinea, however, much of the country occupied was fairly evenly if lightly infested by one or more itch-producing species, and usually the most dense patches could not be "spotted" except by laborious boot collecting.

Similarly the avoidance of typhus-infested localities had possibilities in Queensland, where certain training areas to which infestation had been traced by hygiene authorities were placed out of bounds, and substitute areas were available. In New Guinea infestation was more widespread and its distribution was difficult to forecast (Kohls, Armbrust, Irons and Philip, 1945). The avoidance of infested localities by an army would clearly be impracticable in forward areas and very difficult to achieve in island base areas.

Locality disinfestation for control of Trombiculid larvæ has been described or recommended by several workers (Ewing, 1921, 1927; Miller, 1925), the method advocated being to clear undergrowth and dust the ground with flowers of sulphur. Allman (1938) failed to obtain a satisfactory "kill" of *Acomatacarus* in Sydney with various sulphur dusts and sprays. Smith and Gouck (1944) also failed to obtain a complete "kill" of chiggers, though they greatly reduced their numbers by the use of dusts of sulphur, dinitro-ortho-cresol, or DDT on the ground.

In Queensland in October, 1944, the water-soluble sodium dinitro-ortho-cresylate was tested against *Trombicula minor*. On plots of 25 square yards infested by numerous mites, dosages of 6, 12, 24 and 36 pounds per acre were applied as a 1% solution in water. For one series of tests five points of rain fell during the night after the spraying; for the other the weather remained rainless for two weeks. The mites were in the shade until 11 a.m. in thick, short grass beside a jungle.

The heavier dosages were followed by a considerable reduction in population, but some mites always remained in the plots, and ran on to boots when examined during the subsequent three weeks. The removal of all vegetation and perhaps half an inch of surface soil greatly reduced mite numbers; but even this treatment followed by spraying with six pounds of sodium-dinitro-ortho-cresylate per acre did not give a complete "kill".

Locality disinfestation, of course, holds little possibility of practical value for forward troops; but efficient sterilization of camp sites would be valuable for base troops. Normal clearing with the keeping of the area tidy and free from regrowth, both in grass and in jungle country, greatly reduced but did not eliminate the mite population (McCulloch, 1944). The drastic bulldozing away of surface vegetation and soil, which was employed in some recent camps, presumably removed all mites from the treated area. In 1943, when unprotected troops camped in new and infested sites, as a general rule scrub itch and scrub typhus both showed sharp rises in incidence, followed in a few weeks by a decline. Subsequently, when men experienced mokka bites, the infestation could usually be traced or attributed to the ground outside the camp area. There have been exceptions, however. At Dobodura two or three cases of scrub typhus occurred in a general hospital six months after the formation of the camp and after the relaxation of anti-mite clothing treatment. At Lae four cases occurred among walking patients on a site then twenty months old. For both incidents it was reported as almost certain that infection had occurred within the camp area. If this was so, the most probably correct explanation would appear to be the dropping by a rat of infected engorged larvæ in a situation favourable to the development of the adult and next generation of larvæ, and accessible to troops.

Observations on the Habits of Larval Trombiculid Mites.

General.

Some account has been given previously (McCulloch, 1944) of the habits of larval Trombiculids dealt with in these studies. The present notes are supplementary. In New Guinea most collecting was done from boots in the course of mite surveys at Koitaki, in the Buna, Dobodura, Oro Bay area, at Dumpu and in the hilly country north of the Ramu, at Nadjab, at Lae and in the Finschhafen area. Mokka-bitten troops were collected from at Dobodura and Dumpu. No systematic collecting from wild animals

was attempted, though occasional lizards and bandicoots and rather more numerous rats were examined. In Queensland boot collections were made at Cairns and at many places on the Atherton Tablelands. On the tableland also the writer received all the Trombiculids from 129 small wild animals trapped in a survey organized in January, 1945, by Major F. Fenner. At Morotai boot collections were made in the Australian camp areas. In Borneo these collections were made or attempted at Labuan and at some twelve centres on the mainland between Papar and Lutong, at Kuching, at Tarakan, and on the coastal strip for twenty miles north of Balikpapan. In the Labuan area also some sixty camp-caught or house-caught rats were examined.

In boot collecting one stands or squats or sits on a low seat (Figure XI), picking up mites as they appear on the boots with a camel hair brush dipped in alcohol. The

FIGURE XI.
Collecting *Trombicula minor* in the scrub-edge belt, North Queensland. (Photograph Military History Section.)

larvæ are unengorged and therefore small, ranging in size from one-fifth (for example, *Trombicula deliensis*) to one-third (for example, *Acomatacarus* sp.) of a millimetre in overall length. On leather the most active travel about one inch in four seconds.

Boot collecting is arduous and slow. It is necessary to keep the feet almost still for fifteen minutes before regarding a piece of ground little more than twelve inches across as having no active mites. Also, specimens may be lost by their reaching the treated socks before being seen. In jungle shade the smallest species are very nearly invisible. An inert object has the advantage over boots that mites reaching its top there remain comparatively conspicuous for a time, and in bad light it can be picked up or knelt over for close examination. Nevertheless, except in patches of dense population, more mites always appeared to be attracted onto boots than onto other objects beside them. The equipment finally carried was a low seat, a black-handled machete and polished leather scabbard to be placed on the ground between the boots, and a rag to keep surfaces clean.

In spite of its limitations, boot collecting has been most important in expanding knowledge of Trombiculids in the tropics. Two or three experienced men can in a day form an opinion as to whether a proposed camp site is lightly or heavily infested with itch-causing forms. A spot having been incriminated as typhus infected, the population of mites seeking to attack man can be surveyed. But in order to attempt a thorough knowledge of mite population in any area, collections from animals are also, of course, essential.

The two methods often give considerably different pictures. Thus, *Trombicula deliensis* and *Trombicula fletcheri* in New Guinea were always taken in small numbers on boots (diary records from Buna indicate an exceptional maximum of ten specimens of the two species per man hour), but were usually present on rats and not infrequently at the rate of over 100 per rat. In Queensland, in typical scrub-itch country, bandicoots and other small animals carried occasional specimens of *Trombicula minor* among hundreds of *Neoschöngastia hirsti* and *Neoschöngastia cairnsensis*. The last-mentioned species were never taken on boots. In Borneo *Trombicula bodensis* was exceedingly rare on boots. No specimens were taken in four days' search by two men in jungle in the neighbourhood of Kuching, yet a mouse deer captured there carried over 1,000 of this species, presumably (since they represented all stages of engorgement) picked up at various times in the previous two or three days. The mouse deer was described by Dr. Banks, of the Kuching Museum, as living in jungle without any nest or permanent camp.

The apparent immunity of many animals to itch caused by larval Trombiculids has been mentioned by the writer elsewhere (McCulloch, 1944). That man acquires immunity to irritation by prolonged exposure to attack is stated by some authors (André, 1932) and doubted by others (Miller, 1925; Fuss and Hauser, 1933). On the Atherton Tableland, the majority of timber workers interviewed claimed to be immune from itch, though to have suffered from it as children, or when first living in the area.

The writer's observations on some aspects of Trombiculid behaviour differ from those of Gunther (1939, 1940), who believed that mites were picked up by men as they brushed against vegetation or sat on logs or stumps. He also considered that the clearing of jungle in infested areas stimulated mite activities. Of types of country in relation to mite population, he considered grassed hillsides to be comparatively free, and dense jungle and swampy ground (including sago swamps) to be normally heavily infested. Gunther dealt extensively with collections from animals, and for observations on larvæ as they seek to attack man, he presumably had to depend mainly on reports by men attacked by mokkas.

Military activity, with the concentration of great numbers of men in country previously only occasionally visited by Europeans, and the use of phthalates to protect them, have given army observers a great advantage. But where the observations conflict, this may be due to differences in terrain. Gunther worked mainly in the high (over 3,000 feet) and rugged goldfields district; with the exception of Koitaki (2,000 feet) and some peaks in the Ramu area, the writer collected only below 1,000 feet and usually near sea-level. In those situations it would be completely exceptional for mites to be picked up from trees, bushes or grass; the clearing of jungle reduces and does not increase the mites seeking to attack man; while mites could be found only rarely in sago swamps. Grassed hills were less heavily infested with mites than jungle or kunai flats, but certainly in some areas carried considerable typhus infection.

Gunther described mokka-biting as occurring mainly under pressure areas (garters and belt) and in the axillæ and crutch. He could not have seen the ankle-biting which became such a feature of attack by *Schöngastia* on troops in the lowlands. In the writer's experience in Queensland, *Trombicula minor* did attack mainly on the trunk. Gunther knew of no scrub typhus in Papua, but many cases appeared when military personnel were exposed there.

Notes on Individual Species.

The collections made in the course of these studies included some 45 species, of which nine have been described as new (Womersley, 1944, 1945) and some twelve remain to be described. Some were found in large numbers, others were widespread though never numerous, and of others very few specimens were taken. Only those considered to be of unusual interest are discussed here.

Trombicula.

Trombicula samboni Womersley occurs in huge numbers at Robe in South Australia, infesting soil under grass, typically close to belts of "blue tea-tree". The mites were said by local inhabitants to "redden a gun laid in the grass among them", especially in the late summer. They were reported to attack horses, cattle and sheep, as well as rabbits (considered by Womersley the principal host) and man. None of the few infested sheep examined by the writer seemed seriously harmed by clusters of mites on the lower parts of their legs.

Trombicula minor Berlese (Figures I and II) occurred on the Atherton Tableland, typically in large numbers in short grass at the edge of jungle, and in smaller colonies along jungle tracks, and under the heavier shade trees of savannah near jungle. Very few specimens were found on the heavily shaded jungle floor. A few were taken on scrub hens' nests in the jungle. This species was always on the ground—never on rotten logs or stumps, a situation said by local inhabitants to be characteristic of "scrub itch". When three men attempted, in a heavily infested spot, to collect all the mites appearing on the boots on one sitting without moving his boots, approximately 200 were taken in ten minutes, but many escaped collection, disappearing under the anklets.

How the larvæ detected the presence of a prospective host was not understood. Earth movement when one stands among them would seem to offer an explanation, but not the only one. When an object, such as a spectacle case, was put among them they crowded onto it. Left and returned to in five minutes, it was found to have but one or two mites on it, the population returning as one watched. A framework was arranged, so that one could inspect the case from above, the support of the framework being on the ground three feet from the case (Figure XII).

FIGURE XII.

Watching mites as they crawl on an object placed on the ground. (Photograph Military History Section.)

Again, within a minute of one's arrival to inspect the case, crowds of larvæ would appear. Breathing on the case was considered to stimulate them, but, when the breath was carefully directed away, they still responded to one's presence with almost equal speed, crowding onto the case, but retiring in a few minutes to the soil.

In the late autumn and winter, this species was seen to be active when the shade temperature on the surface of the ground was over 66° F., sluggish below 65° F., and almost completely inactive below 60° F. At night the mites appeared to be influenced by the temperature only—not at all by darkness.

A dog frequently exposed to large numbers of *Trombicula minor* and *Trombicula gymnodactyla* had very few mites attached, all belonging to the first species.

Trombicula wichmanni Oudemans (the writer's identification) was the only species taken in numbers on boots in Borneo. It also occurred in Morotai and New Guinea. Fairly dense patches were found in jungle near Brunei and Balikpapan. It was the only species found in the country near Balikpapan where scrub typhus infection existed, and so must be suspected as a potential vector of the disease.

That *Trombicula wichmanni* is truly distinct from *Trombicula minor* seems doubtful. Some series of specimens appeared to the writer to grade into *Trombicula minor* var. *deliensis* Womersley and Heaslip, which is the variety treated by Major G. M. Kohls as *Trombicula buloloensis* Gunther and discarded by Womersley (1944) as *Trombicula minor* Berlese.

Trombicula gymnodactyla (Womersley, MS.) was found in October, 1944, on the Atherton Tableland, as numerous in some areas as *Trombicula minor* but in more shaded situations. A few occurred in the thick patches of *Trombicula minor*, but they were also thinly distributed on the floor of thick jungle, where that species could rarely be found. The most dense patches of *Trombicula gymnodactyla* were just inside the jungle, or under regrowth thick enough to exclude grass. By the end of the dry season (December), specimens were hard to find. It is assumed, but not at the time of writing proved, that this species will attack man.

Trombicula deliensis Walch and *Trombicula akamushi* Brumpt are considered by Mr. Womersley to include respectively *Trombicula walchi* Womersley and Heaslip (Figures XIII and XIV) and *Trombicula fletcheri* Womersley and Heaslip (personal communication, 1945). They were taken in nearly all areas visited by the writer in New Guinea. Though sometimes numerous on individual rats, they were always scarce in boot collections where they were relatively slow-moving and often slow to appear, the first not infrequently being seen ten or fifteen minutes after one had taken up one's position on a given spot. Sometimes they occurred with more numerous *Schöngastia* sp. or *Trombicula minor* and often with small populations of *Guntherana parana* Womersley. Some were found in jungle, but they were much more likely to be taken in kunai. *Trombicula deliensis* was regarded by Heaslip (1941) as the probable vector of scrub typhus at Cairns, Queensland. Both species have been established as vectors in New Guinea by work of the United States Typhus Commission (Kohls, Armbrust, Irons and Philip, 1945).

Knowledge of the reaction of these two species to phthalates on cloth is limited, because both species have been found as unengorged larvæ in numbers so small as to make cloth-testing extremely difficult. Tests, it appears, could have been carried out at Dobodura and Buna in 1943. Specimens would have had to be searched for singly, and many of those tested to prolonged stopping times would have been the small *Guntherana parana* Womersley, indistinguishable until mounted and relatively resistant to phthalates. Such work was postponed in favour of more pressing problems and in the hope that larger populations of *Trombicula deliensis* or *Trombicula akamushi* might at some future date be discovered. Even the sparse Buna populations have not subsequently been reproduced in the writer's experience. The two or three specimens of these two species cloth-tested in *Schöngastia* populations gave stopping times in the *Schöngastia* range. The apparently successful control of scrub typhus by dibutyl phthalate in New Guinea indicates that the vector mites are as susceptible as the itch-causing forms.

Trombicula bodensis Gunther has been referred to above. In addition to being found with great difficulty on boots in various parts of Borneo (Balikpapan, Weston, Limbang and Labuan), and in huge numbers on one mouse deer at Kuching, it occurred in small numbers on three camp-trapped rats on Labuan.

Schöngastia.

Schöngastia pusilla Womersley was the most abundant larva seen on boots at Dobodura, and the chief cause of itch. It occurred typically in jungle, but also extended into the kunai. It was also found in considerable numbers in jungle in the Faria River, some five miles (air line) from the Ramu Valley and about 1,500 feet above sea-level, and in jungle on Morotai.

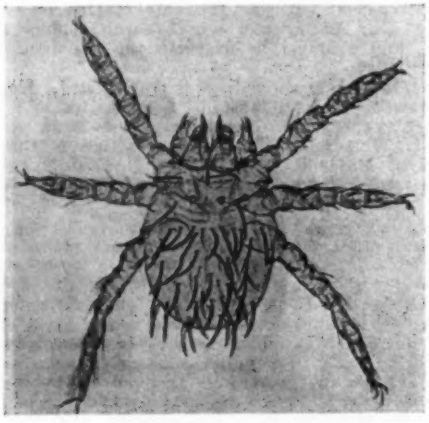

FIGURE XIII.
Trombicula walchi Womersley and Heaslip.

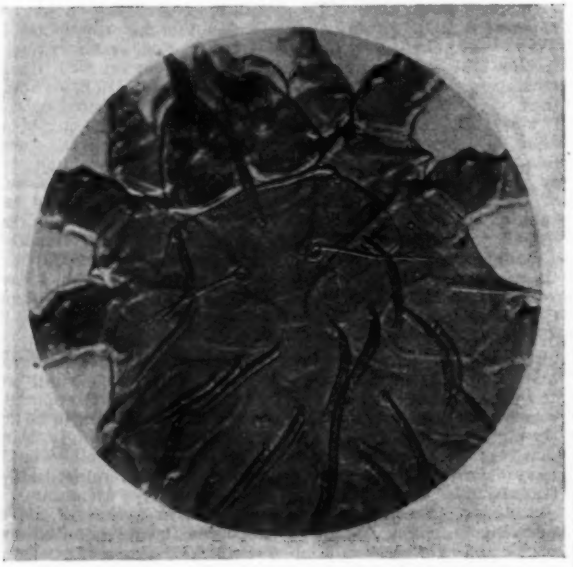

FIGURE XIV.
Trombicula walchi Womersley and Heaslip (scutum).

Schöngastia blestowei Gunther (Figures V and VI) appeared to be very widespread in New Guinea. It was described by Gunther from man in the Sepik district, and from man and bush fowl at Bulolo. It was collected on boots at Donadabu, Dobodura, the Ramu Valley, Lae and Finschhafen, being undoubtedly the chief cause of itch in the last-mentioned three areas, and found in large colonies on rats at Dumpu and Lae. A relatively large and active species, it appeared to be responsible for a high proportion of bites compared with the numbers seen. At Dumpu, men in the country which by Queensland standards was lightly infested, were heavily bitten. At Lae, men wearing clothes thoroughly treated with repellent, except that their boots had not been removed for treatment of socks, experienced five to fifty bites per man on the feet after exposure of one hour where mites were fairly hard to find.

Schöngastia blestowei appeared to be incriminated as a vector of scrub typhus in the Ramu Valley, because it alone was found in one clearly defined camp with a history of scrub typhus infection in the middle of the main valley. It was used extensively in cloth tests at Lae, and regarded as equal to *Schöngastia pusilla* in susceptibility to phthalates.

As has been mentioned elsewhere, the species of *Schöngastia* handled in numbers were extremely susceptible to desiccation, living in damp soil, running about on surface litter when stimulated, but not climbing up vegetation for more than a few inches. Prolonged dry weather led to their virtual disappearance, with a rapid recovery in numbers after rain. It was concluded that men did not become mokka-bitten by walking through infested scrub, but by standing, sitting or lying on infested ground, and that, contrary to popular belief, the use of kunai grass for bedding was not in itself unsafe.

Neoschöngastia.

Several species of *Neoschöngastia* formed the bulk of the material from animals in Queensland. Another species was the most common Trombiculid on rats at Labuan. It was usually so deep in the hosts' ears as to be seen only in the cavity exposed when the ears were cut off flush with the skull.

Acomatacarus.

Acomatacarus australiensis Hirst occurs in certain Sydney suburbs, where it constitutes a considerable nuisance during the warmer months. In March, 1943, it was found in enormous numbers on the ground and on fence posts. When stimulated by the presence of test personnel, it was seen to climb shrubs to a height of at least three feet.

Of *Acomatacarus novaguinea* Womersley, very few specimens were found singly in jungle during cloth tests at Dobodura and Lae. It was highly resistant (in comparison with *Schöngastia*) to intoxication by dibutyl phthalate on cloth.

Acomatacarus athertonensis Womersley was found on the Atherton Tableland in October, 1944, in enormous numbers, chiefly on the tops of stumps and fence posts, but also on the surrounding ground and on logs, where again it tended to crowd to the highest points. The mites could be seen on top of grass stalks three feet high and in very small numbers on shrubs five feet from the ground. They crawled freely along the wires of a fence in shade in hot, dry weather. When attracted onto projecting points of wire or twigs, some were seen to fall, so that it is possible that they may sometimes drop from high branches.

On wood, the mites sheltered in cracks which appeared completely dry, and in test tubes they survived starvation in a very dry atmosphere (extreme recording 91° F., relative humidity 23%) for a week. It is considered that this resistance to desiccation, and also their relative resistance to dibutyl phthalate, may be related to respiration by tracheæ in *Acomatacarus* (Womersley, 1944).

On present-day evidence species of this genus seem unlikely to be vectors of scrub typhus.

SUMMARY.

Australian research, with the object of protecting troops from scrub typhus by anti-mite treatment of clothing, began early in 1943, following a confidential report from United States workers that dimethyl phthalate, the recently adopted mosquito repellent, held great promise.

Field experiments in which men wearing impregnated clothes exposed themselves to attack by larval Trombiculid mites in Queensland and New Guinea are described.

Dibutyl phthalate at a dosage rate of one fluid ounce per set of clothes was recorded as giving protection until exposure ended at twenty-two days, the clothes having then

been cold-water washed eight times. Dimethyl phthalate and DDT gave very much less satisfactory protection.

A technique for testing the toxicity of some miticides on clothing was developed. By its use many details influencing the employment of dibutyl phthalate in the field (for example, dosage rate, method of laundering clothes, the influence of sweat and rain, the effect of the storage of treated clothes) were studied.

Methods by which clothing might be impregnated most efficiently were examined in some detail. Application by hand by the individual soldier under supervision was decided on. Application by hand, fortnightly, of one fluid ounce of dibutyl phthalate to each set of clothes became the standard anti-mite treatment for Australian troops. Detailed instructions in the method are given in the appendix.

The results of the use of dibutyl phthalate by troops in action against the enemy were studied in various areas. The claim is made that the treatment proved capable of giving practically complete freedom from scrub typhus.

The possibility of control by locality disinfestation or avoidance of infested areas is discussed.

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An indispensable part in these studies was played by those men of 2/7 Australian General Hospital, 2/31 and 2/33 Australian Infantry Battalions, and 2/4 and 2/6 Australian Field Ambulances, who volunteered for and exposed themselves to experimental risk. In the course of the work help was also asked of and most willingly given by a great number of officers, of whom Colonel J. G. Hayden and Lieutenant-Colonel Bruce Hall may be specially mentioned. Thanks are also due to Lieutenant-Colonel I. M. Mackerras for direction of the work and for much assistance in preparing the manuscript; to Colonel E. V. Keogh and Colonel E. Ford for the table from which Figure I is drawn; to Mr. H. Womersley for his advice on the identification of mites, and to Mr. D. A. Gill and Mr. E. Parrish for the photographs of mites. The writer had the benefit and great pleasure of many exchanges of information and opinion with officers of the United States Army Typhus Commission, particularly Lieutenant-Colonel C. B. Philip, Major G. M. Kohls and Captain R. C. Bushland. Finally permission for publication is acknowledged to the Director-General of Medical Services, Major S. R. Burston.

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APPENDIX.

Instructions Issued to Officers and Non-Commissioned Officers: Protection against Scrub Typhus.

Scrub typhus can be prevented if clothes are treated with anti-mite fluid. This fluid is harmless to the skin and clothes, but poisonous to "mites", and it resists washing much better than mosquito repellent lotion.

(a) Frequency of Application.

One treatment protects until the clothes have been washed cold or warm with soap or "Persil" seven times, or boiled (ten minutes) with soap three times. Sweat and rain do not affect this time. Generally, therefore, under field conditions, treatment should be done every fortnight. Treated clothing put away and not washed will remain protective for at least two months.

(b) Amount Used.

One fluid ounce (two tablespoons) is used for one set of clothes—shirt, trousers and socks.

(c) Method of Application.

The fluid is rubbed into the cloth (all cloth in contact with the body) by hand. Dipping is out of the question and spraying must be avoided as it gives erratic results.

Details.—Each man receives his issue (enough to treat all his clothes, worn and unworn) in a tin. He dips the finger tips of one hand into the fluid, taking out enough to give a light smear over the inner surfaces of the two hands. With the smeared hands he rubs the fluid into the material with an action like that of washing, or he may spread the clothes on a flat surface, for example, a ground sheet on the ground, and wipe the hands firmly over them. Socks and trousers being worn may be stretched and rubbed against the skin, but a shirt must be taken off and turned inside out to avoid the pockets. From the point of view of protection it does not matter which side of the cloth is treated. There are at least 75 light smears in a fluid ounce. Heavier smears would give a patchy cover. Success depends on thoroughness. The full quantity must be used thus:

Socks: Six smears to each. If no socks are worn, six smears inside each boot, but treated boots will not protect if worn with untreated socks.

Trousers: Ten smears to each leg, ten about waist and fly.

Shirt: Six smears to each sleeve and twenty on the body of the shirt. If underpants and singlet are worn, extra fluid should be issued to allow ten smears to each garment.

Gaiters: Need not be treated.

The reason for requiring a full cover is as follows. The fluid acts by poisoning mites. This poisoning takes time. Treated cloth that has been washed may take half an hour to kill a mite, in which time the mite can travel for a foot or more, and could therefore cross a treated band and bite under an untreated patch. Double dosage is no more effective than that laid down (one ounce is liberal). Therefore heavy treatment of strips or patches will not protect. Complete cover is essential. To treat a set of clothes takes fifteen minutes.

(d) Distribution.

The fluid is in five-gallon drums. The scale of issue is one ounce per set of clothes per man initially, replenishable fortnightly. Within the unit the fluid should be issued to companies or platoons in clean containers of suitable size (some tins which make convenient measures are listed below). The men parade with all their tropical clothes to be treated, each man with a container in which to receive his issue of fluid. The best container would be a jam tin cut down so that its walls are about one inch high to give the effect of a deep saucer. In New Guinea tobacco tins are used.

The men file past the issuing point and receive one ounce per set of clothes. The fluid should be ladled out with a measure. A two ounce "Capstan" tobacco tin or four ounce cream tin, cut half-way down and fitted with a handle, makes a good two fluid ounce ladle. Clothes should be treated on the spot and under supervision. The clothes may be dry, damp or wet, but preferably dry, as the fluid then "shows up" better. New clothes fresh from the store take and hold the fluid as well as those that have been worn and washed. Treatment of all articles at one time is necessary to avoid confusion later as to which are done and which were not.

When in mite country the men should live and sleep in treated clothes.

Measures: "Kia-ora" fruit tin, thirty ounces; jam tin, twenty ounces; milk tin, twelve ounces; "bully beef" tin, eight ounces; two ounce tobacco tin, four ounces.

(e) Results.

Where anti-mite fluid has been made available, its use has been followed by a considerable reduction in scrub typhus. Where typhus has occurred, failure in distribution has been by far the most important factor—for example: whole platoons or sections have been sent no fluid or too little; men returning to units have not immediately received fluid, and have worn untreated clothes until the next general issue; new clothing (particularly socks) has been taken forward and issued without fluid.

All available evidence indicates that where men are given the fluid and shown how to use it, they get results.

SOME REMARKS ON PSYCHOTIC EX-SERVICEMEN.[1]

By A. T. EDWARDS,

Medical Superintendent, Mental Hospital, Callan Park, New South Wales.

RECENT investigations in the American and English armies have stressed the frequency with which a previously inadequate or maladjusted personality is found in servicemen who develop neurosis or a psychosis. W. T. Brown and Merril Moore,[(1)] for instance, found in one random sample that 93 out of 100 patients had had definite psychiatric disturbances before enlistment; in another sample, out of 146 psychiatric casualties occurring during or soon after action, 38% gave a history of mental illness. In the British Army, H. B. Craigie[(2)] found in the Middle East that 79% of non-battle casualties had had such a previous history. Allied to these findings is the fact that non-battle stresses and conflicts appear to be more constant and more powerful ætiological factors in these psychiatric casualties. A. J. Sinclair,[(3)] for instance, found that only 40% of his patients had been in contact with the enemy in even the most remote way. A long-lasting psychosis appears from the literature to be a rather unusual result of battle stress only.

An examination of the statistics in reference to the first 213 certified ex-service patients admitted to the Mental Hospital, Callan Park, during the recent war leads to conclusions similar to the above. This number represents 195 certified under the *Lunacy Act* and 18 under the National Security Regulation 47 from the outbreak of war until the 114th Australian General Hospital at Kenmore became a fully functioning unit. Patients admitted after that have been excluded, as they represent only the more disturbed or more chronic types of mental disorder. Of the 213, 155 or 70% belong to the schizophrenic group, including schizophrenia proper and paraphrenia. This agrees with the finding of H. B. Craigie, whose figure for schizophrenics was "over 50%". This, of course, is to be expected from the age incidence, as 81% were under forty years of age and 48% under thirty. The other large diagnostic group, manic depressive psychosis, was represented by 20% of the total. Epileptic psychoses, confusional psychoses, largely psychogenic, and *dementia paralytica* together account for the other 10%.

In an assessment of the prepsychotic state of patients, it is difficult to avoid bias, as both the psychiatrist and the relatives tend to magnify any forms of behaviour that in retrospect do not appear to have conformed completely to their conception of normal. It is therefore desirable that purely objective standards be adopted, and, in this series, previous hospitalization for mental illness, two or more convictions for alcoholism, actual insanity at the time of enlistment and epilepsy are considered as definitely objective criteria.

Of the 213 patients, 65 had a history of having previously been certified insane, or of having been admitted to hospital for a neurosis or a psychosis; eleven others were insane on enlistment (one of these was actively hallucinated and delusional for fourteen months before he was certified); a further twenty-one had had at least two convictions for alcoholism; seven others were epileptic and two syphilitics developed *dementia paralytica*. Definitely objective pre-enlistment signs that denoted a tendency to the development of mental disorder therefore existed in 106 or exactly 50%.

Less objective evidence was available in the following cases: seven were homosexuals; eleven had long-standing sex conflicts of a pathological degree; seven were obviously over-dependent on an over-protective or dominating mother (of these, an outstanding example was a young airman who always slept with his rather youthful mother whenever he was worried; at the age of twenty, he slept with her on the night before going into camp); and eight had other definite and obvious signs of inadequate personality; these represent a total of 33. If we add these two totals, we find that at least 65% showed evidence of inadequacy.

It is interesting to note that fear in battle and Malayan conditions were factors in only ten cases altogether; fear of active service occurred as a causative element in the case of sixteen men, who had not been in contact with the enemy.

The most common recent factor was mental conflict as the result of camp life, generally associated with a feeling of inadequacy; this was considered to be of ætiological value in no fewer than 53 instances. As would be expected, out of the 53 patients displaying this type of conflict, 41 were diagnosed as suffering from schizophrenia. These patients were for the most part quiet youths of introverted schizoid personality, living a restricted but protected existence. An unusually large number were from country centres. Cast into the midst of men *en masse*, their personality soon made them the butt of the usual camp jokes as well as of veiled or open accusations of homosexuality generally intended as a joke, but taken by the patients at face value. Men in the herd are cruel, and fall upon this type of individual as the pack falls on the wounded wolf. The psychosis that ensued was generally schizoid in character, but fortunately with quite a fair prognosis. It can be logically maintained that the psychosis of these patients was as much the result of war service, even if they never left Australia, as are the psychoses developing in operational areas. The only other single causative factor that was numerically important was domestic conflict, which occurred in 26 cases; of these cases, more than half were the result of infidelity on the part of the wife during the absence of the husband on service.

Of the 213 patients, 81 had been in the service less than three months and 31 between three and six months; that is, 53% had less than six months' service. Allied to

[1] Read at a meeting of the Section of Neurology, Psychiatry and Neurosurgery of the New South Wales Branch of the British Medical Association on November 28, 1945.

this is the fact that only 43 (20%) had in any way been in contact with the enemy. (Compare A. J. Sinclair's 40%.) There is a very rapid decline when the length of service is tabulated at six monthly periods (see graph, Figure I).

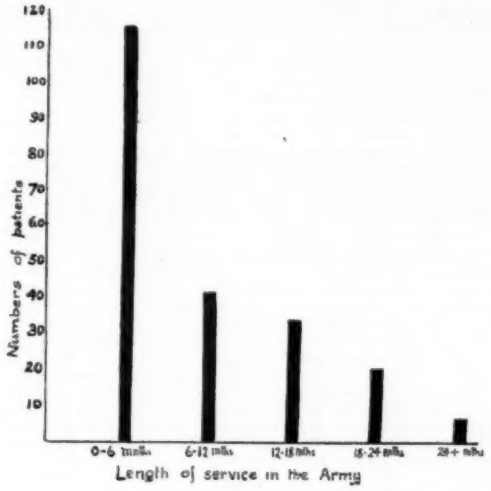

FIGURE I.

The result of treatment is interesting, as it tends to bear out H. B. Craigie's conclusion that the schizophrenic episodes occurring in the services were of better prognosis than in civilian practice. This may be explained by the fact that so many of these episodes were motivated by the stress of intolerable community life as stated above, and, therefore, were more likely to respond to treatment than the more slowly developing schizophrenic process of civilian life. Probably as a result of this the schizophrenic-paraphrenic group displayed greater affective disturbance than appears in the similar group amongst civilian patients. This affective disturbance generally appeared as anxiety, a symptom which I have found remarkably rare in civilian schizophrenics. It was found especially in the group of schizophrenics in which stresses of camp life had assisted in determining the psychosis. Of the 41 in whom these stresses had occurred, 29 displayed anxiety as a definite symptom, the anxiety generally being attached to the idea of being compelled to return to camp.

Treatment was predominantly of the shock type—at first by "Cardiazol" or "Phrenazol", later by electro-shock. Of the schizophrenics, 98 or 66% recovered; of the manic depressives, 96%. The fact that there was an affective disturbance superimposed upon the schizophrenic process so frequently, probably accounts for the results of shock therapy being so much more favourable than is usual in this type of illness. Recovery was considered satisfactory if an adequate social adjustment was made—full insight was not considered necessary.

It is not known to what extent similar investigations into the psychoses which have developed since the opening of the 114th Australian General Hospital would support the above figures. The Callan Park results, however, approximate very closely to figures and conclusions given by British and American writers which tend to show that the psychoses which occur as the result of actual battle stress are relatively small compared with: (*a*) those resulting from causes which are in no way connected with war; (*b*) those resulting from causes which are a combination of service conditions and preexisting personality inadequacy; and (*c*) those resulting from the interaction of service conditions and extra-service problems.

Summary.

The causation of the mental illness, length of service and results of treatment of the first 213 ex-service patients of the 1939-1945 war admitted to the Mental Hospital, Callan Park, are numerically considered.

It is stressed that psychoses occurring as the result of conflicts due to camp life should be considered as being due to war service.

The conclusions to be drawn from the figures concerning causation agree with those made as the result of similar investigations in reference to British and American servicemen.

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(1) Warren Brown and Merril Moore: "Soldiers who Break Down", *Military Surgeon*, March, 1944; quoted in "Year Book of Neurology, Psychiatry and Endocrinology", 1944, page 384.

(2) H. B. Craigie: "Two Years of Military Psychiatry in Middle East", *British Medical Journal*, July 22, 1944, page 105.

(3) A. J. Sinclair: "Psychological Reactions of Soldiers", THE MEDICAL JOURNAL OF AUSTRALIA, August 25, 1945, page 229.

Reviews.

PULMONARY ŒDEMA AND INFLAMMATION.

A MONOGRAPH by Dr. Cecil K. Drinker, Professor of Physiology in the School of Public Health at Harvard University, on pulmonary œdema and inflammation has for its subtitle "An Analysis of Processes Involved in the Formation and Removal of Pulmonary Transudates and Exudates".[1] The little book is one for the physiological or central medical library rather than for every physician; but it so happily applies physiological thinking and research to the clarification of clinical problems and is so short and pleasantly written that it can be safely recommended to the physician, especially the physician interested in diseases of the chest, who wishes to undertake during an evening or two or three an "orientation course" in pulmonary physiology. In a chapter on preventive and therapeutic measures in asphyxiating pulmonary disease, Professor Drinker emphasizes and explains the value of the timely administration of pure oxygen under a pressure greater than that of the atmosphere. The cynical physician may affect to see the crux of this chapter in the sentence, "There are many ways for accomplishing this, none too good at the present time". The author adds, however, that his experience in the construction of high altitude masks for supplying oxygen to fighter pilots makes him certain that after the war transparent masks and hoods will become available which will enable the physician to give any concentration of oxygen he wishes under such conditions of pressure as his judgement and the reactions of the patient indicate; also that the patient by virtue of our advances in radio equipment will be able to converse freely with his attendants. The final chapter of the monograph is concerned with principles and methods of artificial respiration and with the various types of breathing machines. The book is well produced.

NERVOUS DISEASES AND THEIR DIAGNOSIS.

IN the preface of the latest revision of his book, "The Diagnosis of Nervous Diseases", Sir James Purves Stewart refers to this edition, the ninth, as "probably my swan song".[2] We hope that this may not be the case and that he may bring out still further editions of his textbook as he has done over the years since it first appeared in 1906. Should this, however, be the last version of the book, which has been an outstanding contribution to neurological literature, then the swan song ends on a high note, as this is probably the most successful of the many editions which the popularity of the work has demanded. It is a manual of clinical neurology, and by its accentuation of the clinical aspect the book will prove of the greatest value to students and post-graduates alike.

[1] "Pulmonary Edema and Inflammation: An Analysis of Processes Involved in the Formation and Removal of Pulmonary Transudates and Exudates", by Cecil K. Drinker, M.D., D.Sc.; 1945. Cambridge, Massachusetts: Harvard University Press. 8¼" × 5½", pp. 116, with many illustrations. Price: $2.50.

[2] "The Diagnosis of Nervous Diseases", by Sir James Purves-Stewart, K.C.M.G., C.B., M.D. (Edin.), F.R.C.P.; Ninth Edition; 1945. London: Edward Arnold and Company. 8½" × 5½", pp. 888, with many illustrations. Price: 40s. net.

The opening chapters are devoted to physiological anatomy, and here enough of structure and function of the components of the nervous system is discussed to form a framework for the remainder of the work. Here again there is clinical application of the subject wherever possible and the text is illustrated by a wealth of excellent diagrams. There follows a case-taking scheme and a gesture to psychiatry by the inclusion of a short section on the investigation of mental patients and the printing of a condensation of the Stanford revision of the Binet-Simon tests. In the remaining sections the various entities of clinical neurology are discussed, such as the unconscious states, convulsive phenomena, upper and lower motor neurone palsy, postures and gaits *et cetera*. The chapters on examination of the cranial nerves, ataxia and the cerebro-spinal fluid are particularly good.

The book is written from a wealth of clinical experience during a lifetime spent in the study of neurology, and the author does not claim that the work is a systematic textbook. However, a section on the psychoneuroses has been included in which the subject has been discussed more from the viewpoint of the organic neurologist than of the practising psychiatrist. Here the various manifestations of hysteria are dealt with very fully. The book contains minor errors which have probably been missed in the difficult circumstances which surrounded the writing and production of this edition, but they are of no consequence. The volume is said to conform to war economy standards, but paper, printing and illustrations are unusually good for a production in the last year of war. The numerous excellent photographs of patients and specimens constitute a veritable museum, and these alone are enough to give the book a great value to those interested in neurology. This work is a mine of information, not confined entirely to neurology, and is one which every practitioner or student of the subject should have on his shelves.

ESSENTIAL HYPERTENSION.

HERNDON'S "Introduction to Essential Hypertension" is a slim volume of attractive appearance, and is undoubtedly a credit to the author and also the publisher.[1] All the relevant facts, including a *résumé* of the modern work on this important disease, are compressed within its 88 pages. This is accomplished by the omission of all extraneous matter and by brevity and conciseness. In spite of this condensation, the book is well written and easy to read, and the most important facts are picked out in bold print. The references are listed conveniently at the bottom of each page, and there are well over 200 of them. At the end of each chapter there is a convenient summary.

The book is arranged in eight sections dealing with normal regulations of blood pressure, ætiology and mechanism, physiology, pathology, clinical aspects, prognosis, diagnosis and treatment. There is also an index.

In discussing the ætiology of essential hypertension, the author, after summarizing the available evidence, is of the opinion that the mechanism is humoral in origin, since the process is reversible, and denervation does not abolish it. It can arise from kidney disease, but this is not the general rule; and the increased vascular resistance is not due, primarily, to organic change in the vessel walls. The vast amount of work on experimental hypertension produced in animals (following Goldblatt's work) has now shown that the rise in blood pressure is due to the elaboration of renin by the affected kidney. Renin is a proteolytic enzyme similar to pepsin. Renin reacts with a substance in the blood stream (pre-angiotonin) to form angiotonin which is the active pressor and vasoconstrictor. Angiotonin has not yet been isolated from the blood of human hypertensives. Another enzyme has been discovered (apparently formed by the kidney) which destroys angiotonin. This suggests the most recent and the most attractive theory of hypertension, namely, that hypertension is due to a disturbance of the endocrine function of the kidney by which the normal balance between renin formation and secretion into the blood stream and destruction of the effector substance angiotonin is disturbed (page 17). However, the renal origin of hypertension is unproven.

The section on pathology is brief but sufficient, and includes good photomicrographs of arteriolar sclerosis, both in the benign and malignant forms, and also four page-size plates in full colour, showing the progressive changes in hypertensive retinopathy.

The clinical aspects are well described and the grading of Wagener and Keith is adopted. As 50% of hypertensive hearts show coronary sclerosis sooner or later, it is a pity that the clinical aspects of this important condition were not included.

The classification of hypertension is discussed in the chapter on diagnosis under three main headings—essential, nephritic and symptomatic. Under the last heading come physiological, cerebral, cardio-vascular and endocrine hypertension. Essential hypertensives comprise by far the greatest numbers and the diagnosis is arrived at by exclusion.

The final chapter on treatment is excellent. Although there is as yet no specific treatment, "it is a tragic mistake to believe that nothing can be done". Emphasis is laid on the treatment of the patient rather than his malady, and on the great importance of relieving apprehension and fear.

The present armamentarium for treatment includes rest, diet, psychotherapy, drugs, surgery and kidney extracts, and each of these is summarized in a well-balanced manner. A schemata of dosage for the cyanates is given, but it is urged that these drugs should not be used without regular control by examinations of the blood.

The most successful of the surgical procedures is the bilateral section of the splanchnic nerves, with lower dorsal and upper lumbar sympathetic ganglionectomy. A relatively few patients, who are not easy to select, benefit by this operation, but the cause is not removed. Improvement is effected by reduction of the cardiac output. A warning is sounded regarding nephrectomy for unilateral renal disease, because the literature reveals that the number of cases in which improvement has occurred is far exceeded by the failures; the clinician cannot assess the pressor state of the other kidney.

The book ends on a hopeful note. A great deal of experimental work is at present being done on kidney extracts from animals, and although hypertensinase has not yet been isolated, it seems likely that it soon will be, and that it will be used to destroy or to neutralize the pressor substance. If this happens, we stand on the threshold of another great discovery.

In this book Dr. Herndon set out to produce a concise statement of what seemed to be the present concept of essential hypertension, presented in such a way that the practitioner can use it to organize his thoughts on the present and future developments. There is no doubt that he has succeeded, and we earnestly commend this volume.

[1] "An Introduction to Essential Hypertension", by Richard F. Herndon, M.D., F.A.C.P.; 1946. Springfield: Charles C. Thomas. 8¼" x 5¼", pp. 99, with illustrations. Price: $2.50.

MEDICAL LICENSURE EXAMINATIONS.

THE United States of America have produced digests on all doctrines, but none could be more amazing than "Rypins' Medical Licensure Examinations", the fifth edition of which has just been printed.[1] It is difficult to condense scientific subjects, for all sciences are necessarily exact, and to omit anything is to destroy the accuracy of the subject, and that is what happens in this book, which is written primarily as an aid to the passing of the various State licensure examinations in the United States of America. The preface states that there is no attempt to teach anything new; however, the book does not even teach completely that which is old. All the subjects of the medical curriculum are mentioned in the 548 pages, anatomy being glossed over in 45 pages, while medicine is spread over 56 pages, and other subjects are dealt with at similar length. As a result much is omitted, and so the student will find the blank pages at the end of each chapter, which are headed "Personal Memoranda", very useful indeed. Lists of questions are supplied, too; but, as stated in the opening chapter, the book aims to help both the examiner and candidate. It is thus to be assumed that the questions are to save the examiner as much mental effort as possible; but the student will not find adequate answers to all the listed questions. The subject matter generally is badly set out and at times inaccurate (thus infarcts of the lungs and asthma are under the heading of infectious diseases). Space does not permit a complete account of the book's failings. "I owe a cock to Æsculapius" is printed as a motto in the book. However, a far more pertinent quotation would have been: "A little learning is a dangerous thing."

[1] "Rypins' Medical Licensure Examinations: Topical Summaries, Questions and Answers", edited by Walter L. Bierring, M.D., F.A.C.P., M.R.C.P. (Edin.); Fifth Edition; 1945. Philadelphia, London, Montreal: J. B. Lippincott Company. Sydney: Angus and Robertson Limited. 9" x 6", pp. 568. Price: 45s.

The Medical Journal of Australia

SATURDAY, MAY 25, 1946.

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THE SPECIAL REPRESENTATIVE MEETING IN LONDON.

THE annual Representative Meeting of the British Medical Association is always an important event. Before the war the Australian Branches sent their representatives every year to share in the deliberations. No difficulty as a rule was found in the choice of representatives because prominent members of a Branch present in England for post-graduate study were available for selection. This year the Parent Body called a special Representative Meeting for May 1 on account of the introduction by the Government of the National Health Service Bill and of the urgent need that the attitude of the medical profession to the radical changes contemplated in it might be determined. The occasion clearly demanded that at least one representative from Australia should be present, and Dr. J. G. Hunter, the General Secretary of the Federal Council of the British Medical Association in Australia, undertook the journey at very short notice. We are indebted to him for the account of the meeting which is published in this issue.

In order that readers may obtain a proper understanding of the decisions made at the special Representative Meeting and of their significance, they should refer to the issue of this journal for April 13, 1946. In that issue we reprinted the White Paper that had been published in London and contained a general description of the proposed health service. We also published in full a report which had been drawn up by the Council of the Parent Body and circulated together with the White Paper to every member of the Association. It was this report that was submitted to the special Representative Meeting and was finally approved after certain amendments had been made in it. The discussion of this report took up the greater part of the meeting, and it will be seen that the amendments carried were mainly verbal alterations which made the report clearer. The watchword of the meeting, Dr. Hunter tells us, was freedom. If the attitude of the representatives is an indication of the attitude of the whole profession in Britain, then its members are unwilling to have any interference with their professional freedom. It must be clearly emphasized that this does not mean that the profession (as represented by the British Medical Association) is opposed to the setting up of a complete health service. On the contrary it declares that it is anxious and willing to cooperate with the Government in evolving such a service. On grounds of public interest the profession is opposed to certain features of the Government's proposals, for it holds that these features render the bill in its present form unacceptable to the profession and constitute strong reasons for advising the public against its acceptance. It was a coincidence that while the representatives of the Association were discussing the bill at B.M.A. House, the Commons were discussing it at Westminster and gave it its second reading. This enables us to throw light on some of the questions discussed at the Representative Meeting. The representatives declared that there should be no control over doctors in the choice of area in which they would practise. In the House of Commons Mr. Greenwood, Lord Privy-Seal, said (we quote from the *News Chronicle* of May 3, 1946) that up to the present there had been no power to order a doctor to any particular district. Mr. Willink, who had been Minister of Health under the Coalition Government, asked whether there would now be such power. In reply, Mr. Greenwood said: "If to ensure proper distribution of doctors there is to be some direction—and it may well be the case—in my opinion the medical profession will take it." Mr. Greenwood then referred to one of the biggest single housing estates in the South Division of Bristol which had a population of 34,000 persons and no resident medical man—efforts to induce people to go there had failed. On the other hand, in Taunton, with a population of approximately 40,000, there were 56 registered medical practitioners. "That", commented Mr. Greenwood, "is what freedom has meant." It would be necessary to know how the Bristol housing estate was served medically by hospitals, clinics, and so on before an opinion on the justice of Mr. Greenwood's gibe was formed. We must presume that if the complete medical service which the profession wishes to help the Government to evolve is brought into being, some means will be found to secure resident doctors wherever they are needed. If this was not done the service would not be complete. This carries a lesson for us in Australia—the profession, if it would avoid government interference, must see to it that practitioners are distributed in such a way that no district will be overweighted with practitioners at the expense of another. The Minister has told the members of the profession that he has no intention of making them civil servants. It would be interesting to know his definition of a civil servant. He would impose directions and restrictions on the doctor and eventually will have him working on a full-time salary. When he was moving the second reading of the bill (we quote from the *Manchester Guardian* of May 1 and also of May 3, 1946) he said that he was not in favour of a fully salaried service. He did not believe that the medical profession was ripe for it. There must be some degree of reward for zeal and some degree of punishment for lack of it. It was therefore proposed that capitation should remain the main source from which the doctor would derive his remuneration, but it was proposed that there should be a basic salary. Later on in

the discussion Mr. J. S. C. Reid said that medicine was an art that did not take kindly to regimentation. Progress in the past had depended to a large extent on individuals or on small groups of men who very often would never fit into any regimented system. A more detailed and elaborate organization was needed, but as unobtrusive and as little rigid as possible. He thought that they should beware that they did not lose the substance of the human spirit for the shadow of administrative efficiency. Mr. Reid went on to say that the bill enabled the Minister to go nine-tenths of the way towards a full State-salaried service. He then referred to Mr. Bevan's remark about the ripeness of the time, whereupon Mr. Bevan interjected: "There is all the difference in the world between plucking fruit when it is ripe and plucking it while it is green." Another feature of the Representative Meeting was the strong opposition shown to the taking over of the hospitals by the Government. This matter has been mentioned previously in this journal, and in the issue of April 6 a plan for a national hospital service prepared by the British Hospitals Association was published. Whilst admitting that it is right that the State should exercise a general controlling interest because of the fact that it has to foot the bill, the profession holds that there is no need for the Government to go so far as it proposes to go. It is held that, with proper regional supervision and control, the hospitals should be allowed to run themselves and to keep their own trust funds and administer them.

Australian members of the Association will recognize that the organization of the Association in Britain has allowed all members of the profession to become familiar with the intentions of the Government. Members of the Association have had an opportunity through their representatives of expressing their views. Something like 90% of the general practitioners of Great Britain are members of the British Medical Association; 75% of the whole profession are members. Now that the profession has decided on its policy, the question of the next step arises. It was arranged that a conference was to be held with the Minister after the Representative Meeting to discover whether he was prepared to meet the objections of the profession. Should this conference prove abortive, a referendum of the profession will be taken to see whether a sufficiently large number is willing to back the decisions of the Representative Body—in effect whether the profession is united. These then are the happenings of which Australian practitioners of medicine are spectators. The details are worthy of careful scrutiny; this scrutiny will allow lessons to be learned—what to do, how to do it and what not to do. It will also provide an opportunity for a stock-taking of motives, individual and corporate, than which there is no more necessary and salutary exercise.

Current Comment.

MODERN TREATMENT IN ACUTE NEPHRITIS.

IT may be taken for granted that there is a practically universal belief that acute glomerular nephritis is related to an infection by the β-hæmolytic streptococcus. When sulphanilamide and its many derivatives were introduced, it was natural that they should be tried in the treatment of nephritis. Of course, we are so used now to therapy by sulphonamides that will not cause cyanosis and are not prone to cause hæmolytic anæmia that we tend to forget our earlier days of tentative and sometimes heroic dosage with its attendant anxieties. But the difficulty in substituting the less toxic compounds is that their habit of causing a more or less worrying crystalluria is a potential menace in a disease in which the renal output is already embarrassingly low. Since 1938 a team from the department of pædiatrics in the University of Pennsylvania has been working on the use of sulphanilamide in acute nephritis, and Milton Rapoport, Mitchell I. Rubin and Arthur D. Waltz now present their results.[1] They have studied 33 patients, and have adhered to their original treatment with sulphanilamide not only because of its freedom from depositing crystals in the kidneys, but also on account of its low renal toxicity. In a control group of forty cases treatment similar in all other respects was adopted except that the patients received no sulphanilamide. The degree of recovery from the nephritic damage was assessed by examination of the urine and by the Addis urinary sediment count. It was also found that serial observations of the blood sedimentation rate gave an accurate check on the return to normal, though it is conceded by the authors that the factors concerned in changes in this test cannot be stated with certainty. In addition the condition of the cardio-vascular system was carefully watched, and the functional efficiency of the kidneys was estimated by the urea clearance test and the phenolsulphonphthalein test. Radiological and electrocardiographic studies were made to ensure that the heart showed no abnormality that was not obvious on physical examination. The proportions of male to female and of white to coloured patients were balanced in each series. The time elapsing between onset of the disease and admission to hospital was slightly longer in the case of patients treated with sulphanilamide. It will be seen that great care was taken not to load the scales one way or another. The bacteriological state of the naso-pharynx was, of course, investigated, and the usual type of streptococcus was found in 60% of the no-drug group and 55% of the other. The sulphanilamide was administered orally on a fixed plan, each patient receiving one grain per pound body weight daily for five days, half this amount for fifteen days, and then a maintenance dose of ten to twenty grains daily for two to six weeks, the blood concentrations being checked, and the blood cell count watched also. During the first week most of the children were somewhat cyanotic, but only two had any significant drop in the red cell count. The results were not impressive so far as any value of the drug was concerned. All the children made good and complete recoveries, and the investigations showed no evidence of any difference in the duration of the inflammatory process in the two series. No undue toxic effect was observed from the drug, but it appeared to be without influence on either the course or the duration of the disease.

Much more encouraging is the report of Susanta Sen from the Irwin Hospital, New Delhi, on the use of penicillin.[2] This series is small, for only twelve children were treated, and no control series was studied. But the patients were in poor condition, and had either been neglected or were anæmic, or otherwise suffering from indiscriminate use of sulphonamide drugs; in fact the author calls their state on admission to hospital desperate. Advantage was taken of the absence of toxicity due to penicillin, and the fact that most of the children were febrile, even though no focal streptococcal lesion was evident in some cases, seemed a good indication for its use. The dose varied between 5,000 and 10,000 units, administered every three hours, or in some cases every four hours, the total dosage ranging from 192,000 and 640,000 units. One patient died, but in no case were any toxic manifestations or complications seen. The children were very young, none older than eight years, and several between one and two years. Improvement was rapid, but no complete follow-up was carried out, and the author does not claim that the disease was completely eradicated in all cases. It is of interest to learn that the fatal case was that of a child who had suffered several

[1] *The American Journal of the Medical Sciences*, March, 1946.
[2] *Ibidem.*

exacerbations in three months, and before admission to hospital had been treated for twelve days with large doses of sulphadiazine. It is not suggested that this series of cases can be placed beside the former, for the conditions are entirely different. But the brief case histories suggest that some severe systemic infection was present in these children, associated with a nephritis, and even in their desperate condition penicillin seems to have vindicated its reputation for potency and lack of toxicity.

THE CLINICAL SIGNIFICANCE OF COLD HÆMAGGLUTININS.

THE presence of agglutinating bodies for red blood cells in the serum is one of the curiosities of hæmatology. It seems a biological vagary which is hard to account for, and that particular variety of agglutinin which acts in the cold and whose action may be reversed by warming to body temperature has attracted a good deal of notice. Phenomena like hæmoglobinuria after exposure to cold have been known for a long time, the earliest reference going back to the sixteenth century. Landsteiner first described the cold agglutinins in 1903, and commented on the strange reversible nature of the reaction. Since then many observations have been made, but the interest in the process was more or less academic till 1943, when it was discovered that these bodies were closely associated with the disease known as atypical pneumonia. This infection, supposedly due to a virus, attracted a great deal of notice after the introduction of the sulphonamide drugs, for it is resistant to their therapeutic action. War, with its usual series of epidemic disease, produced large numbers of cases of the atypical pneumonia, but, as Lawrence E. Young points out in an article on the clinical significance of the cold agglutinins, there are many immunological questions raised by the work done up to the present that have not been solved.[1] Young has described a standard test which he recommends, and whose details need not detain us here, except to agree that some conformity with a recognized method is desirable in a test that may come into more frequent use in clinical investigations. The study described in this article is derived from data collected in the examination of 1,762 specimens of serum, 145 of these being from 45 patients with atypical pneumonia. Over half these patients showed a titre of abnormal range, but, while the titre rose rapidly during the second week of the illness, no relationship between the titre and the severity of the illness could be established. In many cases cold agglutinins persisted in the serum for some time, and occasionally for many months. In infections other than atypical pneumonia cold agglutinins were usually found only in low titre, except in rubella, infectious mononucleosis and certain conditions associated with enlargement of the spleen.

D. Stats and L. R. Wasserman published an excellent review of cold hæmagglutination several years ago, and remarked that no adequate study had been made of the relationship between this phenomenon and infectious disease.[2] They stated that the titre in infections was usually low, and rises transient. They also specially mentioned the frequency with which cold agglutinins occurred in trypanosomiasis and relapsing fever, but concluded that there was no conclusive evidence that they could be demonstrated regularly in malaria and blackwater fever. Another important topic discussed in this review was the association often commented upon in medical literature between the appearance of cold agglutinins and the onset of vascular thromboses, especially in clinical states when the blood sedimentation rate was increased. The same has been observed in other forms of vascular occlusion. Stat and Wasserman thought that the constant presence of the agglutinins in normal persons deserved further study, although the titre is usually low, and they concluded that the phenomenon was a clinical curiosity, whose significance could not be then assessed. Young, as one of the workers who have applied themselves to these problems, agrees that further work is desirable, and for that reason he hopes that a standardized form of test such as he describes will be adopted, so that knowledge will accumulate.

Other aspects of the subject are of interest and possibly of importance in addition to the relationships with infections and vascular accidents, such as the possibility of some connexion existing between hæmagglutination and hæmolytic anæmias, and also the relevance if any of cold agglutinins in blood transfusion. Recently Sheila T. Callender and Z. V. Paykoç have reported the finding of cold agglutinins in 88 out of 95 patients after blood transfusion, the reaction also taking place to a lessened degree at room temperature in fifteen cases.[1] As the Rh factor may also appear in demonstrable degree after transfusion, there is plenty of room for further work. Here is another instance of what seemed to be purely academic research. True we cannot guarantee that practical results will flow from future work, but at least the problems are closely bound up with bedside medicine. Acquaintance with the history of modern medicine indicates that few ascertained facts are destined forever to be like the seed that fell on stony ground, if opportunity is given to those who will nurture its germination.

[1] *The American Journal of the Medical Sciences*, January, 1946.
[2] *Medicine*, Volume XXII, 1943.

AN UNUSUAL RECTO-VESICAL INJURY.

AN unusual injury to the rectum and bladder of a twenty-six year old Indian soldier is recorded by Rodney Smith, of the Royal Army Medical Corps.[2] The soldier was knocked over by a slowly moving army vehicle. He fell in a sitting position onto an iron pick, the point of which penetrated his rectum. He walked without difficulty to a first-aid post; he had no pain or discomfort, but was sent to a field surgical unit because of blood which dribbled from the anus. Two and a half hours later he could not pass his urine. His bladder was by this time distended. It was thought that because the bladder was distended it could not be perforated. When a catheter was passed, however, pure blood was withdrawn. Operation was undertaken, the bladder being opened. The bladder, which was filling up with blood, had not emptied into the rectum because the perforation was valvular, a triangular flap of mucosa overlying the hole through the muscle. The rent in the bladder wall was repaired, a self-retaining catheter was inserted and the bladder was closed. A left inguinal colostomy was performed and the perforation in the rectal wall was not sutured. Recovery was rapid and complete. The pre-operative distension of the bladder, the absence of pain and shock and the non-suture of the tear in the rectal wall are the points to be noted.

"BLOOD", A JOURNAL DEVOTED TO HÆMATOLOGY.

NEWLY arrived among the journals of the English-speaking world is *Blood, The Journal of Hematology*. The first number bears the date January, 1946. The editorial board comprises well-known hæmatologists. William Dameshek, of Boston, is Editor-in-Chief. There are five associate editors and two assistant editors. The advisory editorial board consists of fourteen, thirteen from the United States and one from Canada. The fact that George R. Minot is consulting editor sets a hall-mark on the journal. Minot in a foreword refers to the importance of hæmatology and insists that it is one of the branches of internal medicine. At the same time he reminds us that medicine has to deal with human personality and human hopes and fears. The clinician must have an active creative imagination and scientific curiosity, but the centre of his activity must be the patient. These are useful thoughts for students of any narrow specialty. This first number of *Blood* comprises 98 pages and contains *inter alia* six articles on special aspects of hæmatology. This journal should have a useful future.

[1] *British Medical Journal*, January 26, 1946.
[2] *The Lancet*, March 23, 1946.

Abstracts from Medical Literature.

THERAPEUTICS.

Actinomycosis.

L. DOBSON AND W. C. CUTTING (*The Journal of the American Medical Association*, July 21, 1945) describe the treatment of actinomycosis with penicillin and sulphadiazine. Three patients were treated with penicillin alone, three with penicillin and sulphadiazine, six with sulphadiazine, one with sulphadiazine and sulphathiazole, one with sulphathiazole and two with sulphanilamide. The lesions were in the jaw, face, neck and lung. All the above methods of treatment were found effective. The dosage of penicillin usually employed was from one to four million units. One gramme of sulphadiazine every four to six hours was given for a month in some cases, but larger doses were used. The same doses of the other sulphonamide preparations appeared effective. The authors state that *in vitro* tests indicate a slightly greater efficiency of sulphadiazine.

Vincent's Angina.

P. L. SHALLENBERGER, E. R. DENNY AND H. D. PYLE (*The Journal of the American Medical Association*, July 7, 1945) describe the use of penicillin in Vincent's angina. Pseudomembrane on tonsils, pharynx or soft palate, with fusiform bacilli in scrapings from these areas, were the criteria of diagnosis. Nine patients were treated with penicillin by local application, by swabbing with a concentration of 250 to 500 units per millilitre four times daily. Control groups were treated by other local and general measures. The results of treatment with penicillin were greatly superior to all other methods employed. Intramuscular injection of penicillin, 15,000 units every three hours for eight doses, was equally successful in two cases. The strength 500 units per millilitre was favoured for local application.

Amœbic Hepatitis.

W. A. SODEMAN AND B. O. LEWIS (*The Journal of the American Medical Association*, September 8, 1945) have reported 33 cases of amœbic hepatitis in New Orleans. All patients were adults and 29 of them were men. All complained of pain in the region of the liver. Fever was present in every case but one, and in thirteen instances was accompanied by chills. Five patients were jaundiced. Only nine patients complained of diarrhœa at the onset or during the course of the hepatitis. Seven other patients gave a history of diarrhœa, so that only 16 out of 33 complained of diarrhœa at any stage. Enlargement of the liver was found in 29 patients and tenderness of liver in all. The leucocyte count was raised in 29 cases, averaging 13,000 cells per cubic millimetre. *Entamœba histolytica* was found in the stools in some cases, but not in all. Impaired movement and elevation of the diaphragm were important signs radiologically. Treatment consisted of six to ten daily intramuscular injections of emetine hydrochloride one grain (0·06 gramme), followed by a full course of "Diodoquin" three tablets of 0·2 gramme each three times daily for five days. If a cure does not result the condition will progress to hepatic ulcers, and in these circumstances the local signs are more obvious and the radiological signs are more frequent. In hepatitis, as distinct from abscess, these radiological signs were present in only half the cases in this series.

"Diodoquin."

D. N. SILVERMAN AND A. LESLIE (*The Journal of the American Medical Association*, August 11, 1945) describe three cases of poisoning by "Diodoquin" (5, 7-diiodo-8-hydroxyquinoline). This drug was used in amœbic dysentery, and it had been claimed that it was quite free from toxic effects. In the three cases referred to "Diodoquin" tablets were given in a dosage of 0·8 gramme three times daily for eight to twenty days. In two cases furunculosis developed about the eighth day, and in one case erythema, fever and chilliness were observed, the rash simulating an iodine rash. The authors believe that that furuncles and the erythema indicated idiosyncrasy to the iodine contained in the drug. In two of the cases mentioned emetine was given in two half-grain doses for four days at the same time as "Diodoquin", but the toxic effects were not considered to be due to emetine. The authors state that "Diodoquin" is an effective drug and that toxic effects are rare.

Suicide by Ingestion of Amphetamine Sulphate.

O. L. GERICKE (*The Journal of the American Medical Association*, August 11, 1946) describes a case of suicide by the ingestion of amphetamine sulphate (benzedrine). The patient took 120 milligrammes, equal to twelve tablets of ten milligrammes each, within half an hour. He complained of pounding in the head and severe frontal headache. He was dazed, but wide awake. Paralysis of the right arm and leg developed, the temperature rose to 103·8° F., the patient became stuporose, and died about seven or eight hours after taking the tablets. At autopsy a large subdural and subarachnoid hæmorrhage of the parietal and occipital lobes was found. No other obvious cause of death was discovered.

Privine Hydrochloride.

S. M. FEINBERG AND S. FRIEDLAENDER (*The Journal of the American Medical Association*, August 11, 1945) describe a condition of nasal congestion due to the frequent use of privine hydrochloride. This drug had been widely used in 0·05% to 0·01% solution, in the form of nasal drops, for the relief of allergic and infectious nasal troubles. In cases of hay fever and allergic rhinitis the drug has been observed to cause increased congestion and nasal obstruction. At first the drops have some vasoconstrictor effect, but this effect diminishes rapidly, and eventually is only transient, whereas in a large proportion of cases swelling of the basal mucosa becomes more marked the more frequently the drug is used.

A Study of Streptomycin.

H. A. ZINTEL, H. F. FLIPPIN, ANNA C. NICHOLS, MARJORIE M. WILEY AND J. E. RHOADES (*The American Journal of the Medical Sciences*, October, 1945) present the results of a study of the absorption, distribution, excretion and toxicity of streptomycin in man. Two series of experiments are reported, the one dealing with the fate of a single dose of the drug and the other with the response to multiple doses. It was found that the blood level of streptomycin following single intravenous injections is better maintained than in the case of penicillin, detectable amounts usually being present for six hours as compared with two and a half to three hours in the case of penicillin even when the intramuscular route was used for the latter drug. The principal route of excretion for streptomycin after parenteral injection appears to be the urinary tract. Following injection the drug is distributed throughout most body fluids, namely, the blood, urine, ascitic fluid, pleural fluid and bile. Small amounts appeared in the spinal fluid of healthy individuals, but in a single case of influenzal meningitis the spinal fluid contained 25 units per millilitre. Little transfer of streptomycin occurs between the blood and the lumen of the gastro-intestinal tract in either direction. Levels as high as 9,000 units per gramme were found in the fæces following oral administration. Owing to the poor transfer of the drug across the walls of the alimentary tract, it would seem appropriate to use the drug both orally and parenterally in the treatment of infections such as those in which the pathogenic organisms are found both in the gastro-intestinal tract and in the blood stream. It was found that early side reactions were not alarming and no late toxic effects have so far been observed. Further studies are in progress.

NEUROLOGY AND PSYCHIATRY.

The Conditioned Aversion Treatment in Chronic Alcoholism.

AFTER mentioning various types of treatment, physical and psychological, in use in chronic alcoholism, J. V. Edlin, R. H. Johnson, P. Hletko and G. Heilbrunn (*The American Journal of Psychiatry*, May, 1945) give details of their aversion treatment. The treatment consists in establishing a reflex aversion to the sight, smell, taste and thought of alcohol by means of an emetic. A routine treatment is indicated, commencing with 25 to 40 minims of fluid extract of ipecacuanha in an ounce of whisky. The complications encountered were difficulty in vomiting, gastric bleeding and diarrhœa which was of short duration and could be controlled. The patient was encouraged to return to hospital every few months to have his aversion reflex reinforced. The average stay in hospital was two and a half weeks. Of an unselected group of patients, 15% remained well. The writers at present regard their treatment not so much as therapy itself, but as a valuable method of interrupting the alcoholic cycle for a conjectural period of time which may be utilized for intensive psychotherapy.

Speech Disorders in the Second World War.

AFTER calling attention to the relatively scant attention paid to the speech defects of war, and referring to the earlier classifications of Gutzmann and of Cobb, William G. Peacher (*The*

Journal of Nervous and Mental Disease, August, 1945) advances the following classifications: (i) dysarthria, (ii) dysphemia (stuttering), (iii) dysphasia, (iv) dysphonia, (v) dysialia. The first group contains disorders of articulation due to lesions of the nervous system, central or peripheral. Rehabilitation is of value, treatment depending upon the involvement and the compensation obtained by the muscles of articulation. Contrary to current opinion many stutterers have adjusted well to army life. Stuttering is occasionally seen following cranio-cerebral trauma and not due to any functional condition. Five types of dysphasia—motor, amnesia, sensory, mixed and total—are described. Dysphonia includes complete loss of voice. Examples seen have been functional or organic (and in many cases adequate examination of the larynx is required). Rehabilitation will depend upon the underlying pathology. Dysialia includes both functional and organic disorders of articulation, exclusive of lesions of the cerebral and peripheral nervous systems, for example, cleft palate, acromegaly, tumours of the tongue and sigmatism. In this article 217 cases have been reported upon; 18% of them followed wounds or exposure to modern warfare. Speech therapy has been found of value, and, in the writer's opinion, should be included during the various phases of rehabilitation.

Central Nervous System in Acute Disseminate Lupus Erythematosus.

DAVID DALY (*The Journal of Nervous and Mental Disease*, November, 1945) contends that originally disseminate *lupus erythematosus* was regarded primarily as a cutaneous manifestation, but that recent investigation has disclosed a much more widespread involvement. In his opinion, it is a systemic disease which may produce damage to the central nervous system. He quotes two cases in detail, giving the pathological findings in the second case in which the patient died while under observation. He finds that neurological signs and symptoms may shift on successive examinations, and that the psychotic symptoms include toxic delirium with, in some cases, coma and convulsions. Post-mortem examination shows the disease to be a diffuse non-specific encephalitis with vascular changes and thrombosis. The etiology of the disease is apparently unknown, but it seems to be connected with a widespread degeneration of the collagen.

The Anticonvulsant Action of "Tridione".

A NEW anticonvulsant, "Tridione" (3, 5, 5-tri-methyloxazolidine-2, 4-dione), has been investigated by Frederick C. Thorne (*The Psychiatric Quarterly*, October, 1945). This drug with its marked anticonvulsant and mild sedative qualities was given to epileptic patients in order to test its efficacy in comparison with phenobarbital and "Dilantin". The patients chosen were mentally defective epileptics who were kept in institutions. It was found that the parenteral administration of "Tridione" was very effective in controlling *status epilepticus* and was without unpleasant reactions. In four cases of *status epilepticus*, when doses of 1·0 gramme were used intravenously the fits ceased within fifteen to thirty seconds. In the eleven patients treated with oral doses of the drug, three were better controlled than with "Dilantin" or phenobarbital, six were essentially unchanged, and two had more seizures than were occasioned by other medicaments. Two patients died for reasons unconnected with "Tridione" therapy. Generally no toxic reactions were noted. The drug is recommended for further trial.

A Fatality Incident to Electroshock Treatment.

ALEXANDER GRALNICK (*The Journal of Nervous and Mental Disease*, November, 1945) is concerned with the possible pathological effect of convulsion therapy upon the brain. He reports the case of a man of sixty years of age who complained of chronic depression and some agitation, who was given two electric shocks (100 volts for one-tenth of a second), and who collapsed and died a few days later. The post-mortem examination revealed a large meningeal fibroblastoma about the size of a small orange lodged in the frontal fossa. There had been previously no neurological signs of tumour. An extensive neuropathological report is published. That the cause of death was œdema from a cerebral tumour is undoubted, but the question of what, if any, cerebral damage may have been caused by the electric shock is left rather undecided. The literature regarding experimental electroshock work with animals is liberally referred to. Apparently the higher one goes in the evolutionary scale, the less is one likely to cause permanent damage to the brain by administering electroshock. And the present evidence seems to indicate that human beings show no specific structural pathological change as the result of electroshock treatment.

Acute Brachial Radiculitis.

G. JOLY DIXON AND T. B. S. DICK (*The Lancet*, December 1, 1945) have studied sixteen typical cases of acute brachial radiculitis. All cases conformed to the syndrome described by Spillane in 1943. The condition commenced with pain in the root of the neck and pain, followed by palsy, which prevented the patient from lifting the arm. Muscular weakness followed, and an area of sensory loss was disclosed over the deltoid region. The authors found that the fitting of abduction splints and the administration of vitamin B_1 appeared to have little effect in treatment. They found that of the sixteen patients studied, ten showed a complete functional recovery in from eight to eighteen months. Of the three patients whose condition is apparently stationary, one has very little debility, the diagnosis is in doubt about the second, and the third patient showed a severe residual deformity. Recurrences developed in five instances.

Spasmodic Torticollis.

AFTER a brief reference to the neurological literature on the subject, Mary T. Paterson (*The Lancet*, November 3, 1945) records the psychotherapeutic results in twenty-one cases of spasmodic torticollis treated at the Jordanburn Hospital. Of these cases, eighteen were considered to be of psychogenic origin and three of possibly organic origin. Therapy consisted of an attempt to correct the faulty emotional reactions and attitudes of the patients. Early emotional influences were investigated, and an analysis was made of the circumstances in which the torticollis first began. Intelligently cooperative patients were given an explanation of their symptoms, while those of less intelligence were subjected to suggestion reinforced with a mild hypnotic. Five patients were completely cured of spasms when discharged, and the condition of five was sufficiently improved for them to resume their work. Seven manifested slight improvement, and four remained unchanged. Seventeen were followed up, and it was found that in thirteen cases the improvement had remained. One patient had neurological signs consistent with an extrapyramidal disease.

Primary Lateral Sclerosis.

CLAIMING that primary lateral sclerosis is a distinct clinical entity, Frederick M. Stark and Frederick P. Moersch (*The Journal of Nervous and Mental Disease*, October, 1945) discuss forty-three cases encountered in the section on neurology at the Mayo Clinic. The number represents 3·7 per 10,000 cases of organic neurological disease. Short histories of eight representative patients are presented. The authors employed the following criteria: (*a*) Insidious onset of the disease. (*b*) Slowly progressive course—rapid progression excludes a diagnosis of primary lateral sclerosis. (*c*) No history or involvement of any part of the central nervous system other than the pyramidal tracts. Retrobulbar neuritis, extraocular palsies, dysarthria, cerebellar signs, sensory changes and sphincter involvement are not regarded as compatible with primary lateral sclerosis. (*d*) The process must have continued long enough for the clinician to be able to assess signs belonging to other tracts. (*e*) Neurological findings must be limited to pyramidal tracts: spasticity, increased tendon jerks, diminished abdominal reflexes, Babinski sign, and at times some muscular weakness.

The Depth of the Physiological Cup of the Optic Disk and Mental Ability.

MORTIMER OSTOW (*The Journal of Nervous and Mental Disease*, December, 1945) has examined more than 325 patients at Saint Elizabeth Hospital; the majority were schizophrenic, affective or organic psychotics. Psychometric data were available for 155 patients at the Medical Centre for Federal Prisoners, labelled psychopathic personality, homosexuality, epilepsy, simple adult maladjustment and latent cerebral syphilis. Depth of cupping was estimated by the usual criteria of steepness of margins, angulation of blood vessels, differences in focal length of lens required to see various points on the disk, evidence of *lamina cribrosa*, apparent colour deviations and so forth. The depth of physiological cupping was positively correlated with intelligence among psychotic patients in mental hospital and among non-psychotic prisoners. The latter group showed a higher correlation than the former. It is claimed that the explanation of these findings may arise in the fact that physiological cupping and intelligence are functions of the excellence of growth and maturation of the central nervous system.

British Medical Association News.

SPECIAL REPRESENTATIVE MEETING.

A SPECIAL Representative Meeting of the British Medical Association was held in the Great Hall, B.M.A. House, Tavistock Square, London, W.C.1, on Wednesday and Thursday, May 1 and 2, 1946. The Chairman of the Representative Body, Dr. J. B. Miller, occupied the chair. The meeting was convened for the purpose of considering a report by the Council (see THE MEDICAL JOURNAL OF AUSTRALIA, April 13, 1946, page 517) on the Government's National Health Service Bill and the Council's recommendation that the statement of policy on pages 3 to 8 of its report be approved.

The Representative Body is the parliament of the British Medical Association and is constituted of 268 representatives (nineteen of whom are members of Council) from 195 divisions, four representatives of the Public Health Service and members of Council, and 42 who are not representatives of divisions. The agenda was very lengthy, comprising 283 notices of motion. A considerable number of motions overlapped, and so it was not necessary to put every one to the meeting, one motion sometimes covering a dozen or so others. Despite this, however, it was found necessary during the course of the meeting to amend standing orders for the purpose of cutting down the time of speakers in order that the meeting might finish on Thursday, which it did at 6.10 p.m.

Meetings of all divisions to which non-members were invited were held prior to the Representative Meeting in order that representatives might be instructed. A copy of the Government White Paper together with a copy of the report of the Council on the National Health Service Bill and the statement of principles laid down by the Negotiating Committee were forwarded to every member of the profession. The meeting was of great importance, as the decisions reached thereat would indicate the attitude of the profession to the Government's proposals.

Prior to the discussion on the Council's report, Dr. J. A. Brown, Chairman of the Conference of Local and Medical Panel Committees, held on the previous day, Tuesday, April 30, gave a brief report of the proceedings of that conference. The conference had been called for the purpose of giving insurance practitioners and general practitioners an opportunity of expressing their views on the National Health Service Bill. The chief decisions of the conference, carried either unanimously or by overwhelming majorities, were as follows:

> That the Representative Body be informed that the report of the Council on the Government's proposals for a national health service meets with the general approval of the conference of representatives of local medical and panel committees.
>
> That this conference will support the Council of the British Medical Association in any action which it may take in order to secure the necessary amendments of the bill.
>
> That this conference approves the seven principles laid down by the Negotiating Committee on behalf of the whole medical profession, but is of opinion that the bill, in its present form, infringes these principles in certain respects.
>
> That this conference does not support the National Health Service Bill, as, in its opinion, acceptance in its present form will inevitably lead to a whole-time salaried service.
>
> That this conference approves the establishment of a comprehensive health service for England and Wales.
>
> That this conference is of opinion that, at the outset of any future National Health Service, health centres must be on an experimental basis only.
>
> That this conference is of opinion that there must be no interference with the present custom of buying and selling practices.
>
> That this conference is of opinion that there must be no direction of a practitioner regarding the area in which he practises.
>
> That this conference disapproves of the proposal that remuneration be by salary, or basic salary and capitation fee, and resolves that it should be by capitation fee only; special areas being dealt with in agreement with the profession.

The first important motion on the agenda of the Representative Meeting was the motion by the Chairman of Council—that the Council's report, "The British Medical Association and the National Health Service Bill", be approved. The Chairman of Council, Dr. H. G. Dain, said that the principles as set out in the Council's report had been established before the National Health Service Bill was published. The profession was now measuring the bill in comparison with those principles. He said that he regretted that no reference was made in the bill to industrial medicine, that little had been said about research and that coordination of the various services was lacking. Under the bill the Minister was really in the position of a dictator. Twenty-four of the seventy-nine clauses gave the Minister power to make regulations. The profession was very much concerned regarding the position of hospitals under the bill. If the bill became law the Minister would be the owner of all hospitals and would be able to prevent any other hospital from being erected. The bill proposed to do away with the trust funds of the voluntary hospitals. The bill also proposed to do away with the purchase and sale of practices. It made void all partnerships. The Association had been stressing the need for group practice, yet because of the savage penal clauses in the bill no one would dare enter into partnership. No provision had been made for assistants. Dr. Dain went on to say that the provisions of the bill relating to the purchase and sale of practices, the distribution of general practitioners with its complication of negative direction and control, and payment by basic salary and capitation fee must receive the very serious consideration of the meeting. The loss of the right to sell the goodwill of their practice, acquiescence in being directed and payment by salary would mean loss of their freedom. Despite the answers which had been given to the *questionnaire* submitted to the profession some time previously, he felt that very few members would now vote for payment by salary. The Minister had said that he had no intention of making doctors civil servants. The doctors, however, would be employed by bodies, executive councils who were under the direction of the Minister, so where was the difference? It was not sufficient for the Minister to say that they would not be civil servants. They must see that the means were not there to enable him to make them civil servants. They should refuse payment by salary and insist on payment by capitation. No reference was made in the bill to the provision of diagnostic services. As had been so often stressed by the Association, these services should be available to every practitioner. Dr. Dain did not expect that they would be able to influence the Government in making amendments to the bill, but arrangements were being made to have amendments moved. He had no doubt that the public would support the profession in its fight for freedom. The bill might become an act by August, and it would come into force on January 1, 1948. Between the passing of the bill and January 1, 1948, they would have to cooperate in the drawing up of the regulations, and when this was done the profession would be able to see where it stood. This would be the time to make decisions as to whether they would take service under the bill. The Minister was never tired of saying that the profession was divided. He could have his socialist medical organization and keep it and see whether it could run a medical service. They could say to the Minister: "You want doctors, we have the doctors." Dr. Dain was given an ovation at the end of his speech.

The meeting then proceeded to consider the various notices of motion. Maintenance of professional freedom both in the interests of the patient and the profession was the keynote of all the speeches, and it was practically unanimously agreed that to surrender their rights to buy and sell practices, to accept direction, or to accept payment by salary would mean surrender of that freedom.

Amendments to Motion Regarding Approval of Council's Report.

The meeting first of all dealt with a series of amendments to the motion that the Council's report, "The British Medical Association and the National Health Service Bill", should be approved.

Diagnostic Facilities for General Practitioners.

An amendment was carried to the effect that diagnostic facilities (such as X rays and clinical pathology) should be fully available to all general practitioners, as well as a consultative opinion.

Regional Organization.

In paragraph 10 of the Council's report reference is made to regional organization. The view is expressed that coordination should always take place at the regional level.

It was resolved that with reference to paragraph 10, the principle of regional organization should be applied to all health services.

Central Advisory Machinery.

Clause 13 of the Council's report with its two subclauses deals with central advisory machinery. It was resolved unanimously as follows:

> That in the constitution of the Central Health Services Council the appointment of medical members by the Minister must be made after consultation with and in agreement with the representative organizations concerned. That the same principle should apply to the advisory committees both in regard to members selected from representative organizations and from the Central Council.

Hospital Ownership.

Hospital and specialist services are dealt with in clauses 14 to 17 of the Council's report. An amendment stating that the meeting approved of the State ownership of hospitals, provided that the constitution of the regional boards was acceptable to the profession and that paragraph 16 of the Council's report was deleted, was put to the meeting and lost; 29 votes were cast for the amendment and 210 against it. It was then resolved with only one dissentient vote as follows:

> That with reference to paragraph 16 of the Council's report, this meeting views with great disfavour the transference of hospitals to State ownership and the consequent destruction of local interest in hospital services, and the confiscation of trust funds intended by donors for specific purposes.

The Buying and Selling of Practices.

In regard to the buying and selling of practices, the meeting by 229 votes to 13 adopted an amendment stating that it regarded as essential in the interests of the public and the profession that doctors should have the right to buy and sell practices as at present.

Distribution of General Practitioners.

Under the heading of "Family Practitioner Services" in the Council's report reference is made in several clauses to proposals to control the distribution of doctors. The meeting resolved by 214 votes to 2 that there should be no control over doctors in regard to the choice of area in which they should practise.

Remuneration.

On the question of remuneration an amendment was adopted by 209 votes to 8, stating that the remuneration of general medical practitioners under any national health service should take the form of an adequate capitation fee without a fixed part salary and without a tapering scale.

General Attitude to the Bill.

Discussion took place on the general attitude of the profession to the bill. Many notices of motion had been received dealing with this subject. One motion was in the following terms:

> That this meeting regards the National Health Services Bill as an important step towards the provision of a comprehensive service available to the whole community, and therefore approves its general framework.

This motion was rejected by an overwhelming majority, only six representatives voting for it.

The following motion which covered many others was adopted with only two dissentients.

> That while agreeing on the need for improvement in and coordination of existing medical services, this meeting disapproves of the methods proposed in the Health Bill to achieve these ends.

Petition, Plebiscite or Referendum.

A number of motions on the business paper dealt with the taking of a plebiscite or referendum of the whole profession regarding willingness to work under the act. It was eventually resolved that it should be a recommendation to Council that a plebiscite of the whole profession should be taken on the question of acceptance or refusal of services under the act.

Disciplinary Machinery.

In regard to disciplinary machinery, it was resolved that the Council should be urged to secure under the bill the right of appeal from the decision of the Minister to the courts.

Powers of the Minister.

Several notices of motion dealt with the powers vested in the Minister under the bill. The following motion was carried unanimously:

> That this meeting views with apprehension the penal powers vested in the Minister by this National Health Bill.

Private Practice.

The following motion dealing with the question of private practice was carried unanimously:

> That any doctor while practising privately either in special or in general practice must enjoy the same privileges and rights and have all the facilities for treating his patients as are now held by all registered practitioners.

Ex-Service Doctors.

The following motion regarding ex-service doctors was carried unanimously.

> That a scheme is urgently required to make available to the public the services of recently demobilized doctors, and that the Council be urged to devise means by which the interests of these ex-service practitioners can be promoted, thereby enlisting their cooperation in the opposition to the bill.

Adoption of the Council's Report.

It was resolved that the Council's report, "The British Medical Association and the Health Service Bill", as amended, be approved.

NOTICE.

THE Ophthalmological Society of Australia (British Medical Association) will hold its sixth annual general and scientific meeting at Melbourne on October 23 to 26, 1946. Any communications regarding the meeting should be addressed to The Organizers, c.o. Dr. W. D. Counsell, Webster House, 85, Spring Street, Melbourne.

Naval, Military and Air Force.

APPOINTMENTS.

THE undermentioned appointments, changes *et cetera* have been promulgated in the *Commonwealth of Australia Gazette*, Numbers 82 and 86, of May 2 and 9, 1946.

AUSTRALIAN MILITARY FORCES.

Australian Army Medical Corps.

VX39709 Lieutenant-Colonel J. B. D. Galbraith is seconded, 11th February, 1946.

S2675 Lieutenant-Colonel J. S. Verco is placed upon the Regimental Supernumerary List, 19th February, 1946.

QX6005 Lieutenant-Colonel (Temporary Colonel) T. A. Parry relinquishes the rank of Temporary Colonel and is transferred to the Reserve of Officers (Australian Army Medical Corps) with the rank of Lieutenant-Colonel and is granted the rank of Honorary Colonel, 17th January, 1946.

WX33954 Major (Temporary Lieutenant-Colonel) C. Fortune relinquishes the rank of Temporary Lieutenant-Colonel and is transferred to the Reserve of Officers (Australian Army Medical Corps) with the rank of Major and is granted the rank of honorary Lieutenant-Colonel, 9th February, 1946.

The following officers are transferred to the Reserve of Officers (Australian Army Medical Corps): Lieutenant-Colonels NX34914 F. W. Niesche, 1st February, 1946; TX2142 M. G. Edison, 16th February, 1946; VX14854 C. A. M. Renou, 26th January, 1946; and WX1525 N. H. Robinson, 9th February, 1946.

VX138724 Lieutenant-Colonel B. K. Rank is transferred to the Reserve of Officers (Australian Army Medical Corps), 2nd November, 1945 (in lieu of the notification respecting this officer which appeared in the *Commonwealth Gazette*, No. 14, of 1946, page 221).

VX15188 Lieutenant-Colonel (Temporary Colonel) J. E. Gillespie relinquishes the rank of Temporary Colonel and is placed upon the Retired List, 2nd February, 1946.

WX3459 Lieutenant-Colonel R. G. Williams is placed upon the Retired List, 26th January, 1946.

To be Temporary Major, 14th February, 1946.—NX116467 Captain K. W. Alexander.

To be Lieutenant-Colonel, 27th September, 1945.—VX138724 Major (Temporary Lieutenant-Colonel) B. K. Rank.

20th Australian Field Ambulance: To be Temporary Major, 19th February, 1946.—QX57362 Captain R. L. Quinn.

WX1522 Lieutenant-Colonel R. R. Anderson, M.C., relinquishes command of 109th Australian Casualty Clearing Station and is placed upon the Regimental Supernumerary List, 19th February, 1946.

The following officers are placed upon the Regimental Supernumerary List: VX15158 Lieutenant-Colonel A. J. M. Sinclair, VX8347 Major (Temporary Lieutenant-Colonel) T. H. Steel, and VX81138 Lieutenant-Colonel J. M. Buchanan, 22nd February, 1946, and NX203622 Captain J. G. O'Neill, 20th January, 1946; VX220 Lieutenant-Colonel W. D. Refshauge, O.B.E., is removed from the Regimental Supernumerary List, 7th January, 1946.

The following officers relinquish the rank of Temporary Colonel and are transferred to the Reserve of Officers (Australian Army Medical Corps) with the rank of Lieutenant-Colonel and are granted the rank of Honorary Colonel: Lieutenant-Colonels (Temporary Colonels) VX14686 D. J. Thomas, 15th January, 1946, VX233 T. G. Swinbourne, 25th January, 1946, and VX14380 C. W. B. Littlejohn, O.B.E., M.C., 21st February, 1946.

The following officers are transferred to the Reserve of Officers (Australian Army Medical Corps): Lieutenant-Colonels NX133935 J. McD. Mack, NX70331 N. R. Wyndham, 6th February, 1946, QX6440 J. M. Yeates, 14th February, 1946, NX18 I. M. Mackerras, 21st February, 1946, NX70268 H. I. Turnbull, 19th February, 1946, VX13621 K. W. Starr, O.B.E., 20th February, 1946, and SX4120 N. J. Bonnin, 9th February, 1946.

SX9182 Lieutenant-Colonel M. R. Gold is transferred to the Reserve of Officers (Australian Army Medical Corps), 28th October, 1945. (In lieu of the notification (second appearing) respecting this officer which appeared in the *Commonwealth Gazette,* No. 14, of 1946, page 210.)

VX315 Lieutenant-Colonel L. G. Travers is placed upon the Retired List, 30th January, 1946.

To be Lieutenant-Colonel, 27th September, 1945.—SX9182 Major (Temporary Lieutenant-Colonel) M. R. Gold.

No. 102 (*Holland Park*) *Military Hospital.*—The following officers are transferred from Australian Army Medical Corps (Medical) Reinforcements with regimental seniority as from date of transfer: Captains Q273988 R. C. Black, 24th December, 1945, and NX208072 W. D. Rimmer, 7th January, 1946.

107th Australian General Hospital: To be Temporary Major, 31st January, 1946.—TX13148 Captain J. A. Oliphant.

No. 110 (*Perth*) *Military Hospital.*—NX205348 Captain J. S. Norton is removed from the Regimental Supernumerary List, 21st February, 1946.

130th Australian General Hospital.—NX207588 Captain J. W. Graham is placed upon the Regimental Supernumerary List, 13th February, 1946.

To be Temporary Major, 15th February, 1946.—NX200954 Captain K. Rubinstein.

6th Australian Camp Hospital.—SX34515 Captain C. J. Helman is transferred from Australian Army Medical Corps (Medical) Reinforcements with regimental seniority as from date of transfer, 4th February, 1946.

10th Australian Camp Hospital.—VX91862 Captain B. Clerehan is placed upon the Regimental Supernumerary List, 13th December, 1945.

2nd/1st Australian Casualty Clearing Station.—VX117222 Captain H. L. McCay and VX108252 Major F. G. Dowling are placed upon the Regimental Supernumerary List, 15th January, 1946, and 16th January, 1946, respectively.

102nd Australian Casualty Clearing Station (*Australian Imperial Force*).—NX140228 Captain (Temporary Major) C. R. M. Laverty is placed upon the Regimental Supernumerary List, 12th January, 1946.

To be Temporary Major, 15th February, 1946.—NX157537 Captain H. O. O. Leggo.

QX24600 Lieutenant-Colonel J. H. Thorp relinquishes command of 109th Australian Convalescent Depot, and is placed upon the Regimental Supernumerary List, 28th February, 1946.

QX6475 Lieutenant-Colonel L. M. Outridge relinquishes command of 2nd/2nd Australian Casualty Clearing Station, and is placed upon the Regimental Supernumerary List, 28th February, 1946.

NX123359 Major (Temporary Lieutenant-Colonel) H. M. Hollingworth, M.C., relinquishes command of 101st Australian Convalescent Depot (Australian Imperial Force), and is placed upon the Regimental Supernumerary List, 28th February, 1946.

NX70338 Lieutenant-Colonel K. B. Noad and NX70628 Major (Temporary Lieutenant-Colonel) T. M. Clouston are placed upon the Regimental Supernumerary List, 28th February, 1946.

QX6264 Lieutenant-Colonel (Temporary Colonel) W. E. E. Langford relinquishes the rank of Temporary Colonel and is transferred to the Reserve of Officers (Australian Army Medical Corps) with the rank of Lieutenant-Colonel, and is granted the rank of Honorary Colonel, 22nd December, 1945.

NX128008 Major (Temporary Lieutenant-Colonel) L. P. Hiatt relinquishes the rank of Temporary Lieutenant-Colonel and is transferred to the Reserve of Officers (Australian Army Medical Corps), 26th February, 1946.

Reserve of Officers.

Australian Army Medical Corps.

The undermentioned officers are transferred to the Reserve of Officers with effect from the dates indicated, and, where applicable, cease to be seconded. Officers holding temporary rank relinquish such temporary rank on the date of transfer to the Reserve of Officers:

Majors V147925 N. R. Dale, 31st January, 1946, V49814 C. T. Stephen, 1st February, 1946, and WX33952 Major W. P. White, 13th February, 1946, Captains V10868 H. T. Hayes, 31st January, 1946, SX28699 J. V. Gordon, 12th February, 1946, NX77177 P. Berger, 8th February, 1946, NX12301 A. G. C. Budge, 26th January, 1946, S48775 R. L. Verco, 23rd January, 1946, V147243 J. C. Pickering, 22nd January, 1946, and VX133071 W. J. Hendry, 23rd January, 1946.

2nd/2nd Australian General Hospital.—VX20305 Major A. V. Jackson, 31st January, 1946.

2nd/6th Australian General Hospital.—Captains TX6482 J. A. Waddy, 1st February, 1946, and QX30148 J. J. Fitzwater, 26th January, 1946.

2nd/11th Australian General Hospital.—VX104284 Captain E. J. C. Claridge, 30th January, 1946.

101st Australian General Hospital (*Australian Imperial Force*).—Majors VX8319 B. L. Hellings, 30th January, 1946, and N392949 R. St. J. Honner, 8th January, 1946, and NX100003 D. L. Graham, 30th January, 1946.

No. 102 (*Holland Park*) *Military Hospital.*—Majors NX175654 E. H. Hipsley, 8th February, 1946, and QX19055 F. J. Booth, 5th February, 1946.

106th Australian General Hospital.—V147191 Captain A. H. Millikan, 12th February, 1946.

No. 110 (*Perth*) *Military Hospital.*—Majors NX103437 G. S. Flynn, 30th January, 1946, and VX114239 O. Alpins, 9th February, 1946, and W16096 Captain M. Kelly, 18th January, 1946.

No. 112 (*Brisbane*) *Military Hospital.*—QX6367 Major A. D. A. Maves, 25th January, 1946.

No. 113 (*Concord*) *Military Hospital.*—Majors NX113197 D. W. H. Arnot, 8th February, 1946, and VX38681 J. Watson, 1st February, 1946, and NX70596 Captain H. J. Delohery, 7th February, 1946.

No. 114 (*Goulburn*) *Military Hospital.*—WX32992 Major A. G. Davies, 31st January, 1946.

No. 115 (*Heidelberg*) *Military Hospital.*—Majors VX48854 G. B. V. Murphy, 26th January, 1946, and NX34846 R. S. Day, 22nd January, 1946, and VX39220 R. S. Lawson, 26th January, 1946.

20th Australian Camp Hospital.—VX39227 Major M. M. Perl, 9th February, 1946.

32nd Australian Camp Hospital.—V148460 Captain W. R. Waddell, 23rd January, 1946.

54th Australian Camp Hospital.—NX123530 Major L. W. Tunley, 31st January, 1946.

75th Australian Camp Hospital.—W28587 Major J. B. Hogg, 2nd February, 1946.

112th Australian Convalescent Depot (*Australian Imperial Force*).—QX45114 Captain N. Y. McCallum, 23rd January, 1946.

1st Australian Outpatients' Depot.—NX103771 Major J. F. S. McKee, 5th February, 1946.

2nd/1st Australian Casualty Clearing Station.—NX111993 Major J. L. Watt, 9th February, 1946.

2nd/3rd Australian Casualty Clearing Station.—NX70610 Major M. P. Ryan, 1st February, 1946.

109th Australian Casualty Clearing Station (*Australian Imperial Force*).—NX201125 Captain R. E. Dunn, 8th February, 1946.

5th Australian Ambulance Train.—Q90148 Major H. A. Retallick, 22nd January, 1946.

6th Australian Ambulance Train.—V85636 Major C. Sullivan, 8th February, 1946.

Inter-Service Medical Wing Demobilization Centres (*Australian Military Forces Component*).—WX32631 Captain J. K. Bowler, 14th February, 1946, and Majors QX23690 C. C. Wark, 3rd January, 1946, and NX131806 K. M. McNamee, 31st January, 1946, and Captains NX154417 A. M. Dan, 9th

February, 1946, NX170035 T. Galbraith, 5th February, 1946, V147727 T. G. B. Allen, 25th January, 1946, and VX117057 E. White, 31st January, 1946, Majors SX3668 J. R. Magarey, 30th January, 1946, and NX135197 J. P. Lyttle, 5th February, 1946.

NX76351 Major J. F. S. Davies, 24th January, 1946, Captains NX35134 A. R. Hazelton, 4th January, 1943, TX6009 E. N. Lee, 22nd January, 1946, VX39095 H. F. Tucker, 16th November, 1945, VX39085 V. Brand, 8th December, 1945, VX39403 A. R. Bush, and VX39972 V. A. Conlon, 16th November, 1945, VX39181 J. L. Frew, 5th December, 1945, and NX70453 J. L. Taylor, 28th December, 1945.

Majors SX27204 W. R. C. Morris, 20th February, 1946, and NX76401 D. R. Reid, 12th February, 1946, V148055 Captain M. C. Curwen-Walker, 14th February, 1946.

2nd/2nd Australian General Hospital.—VX111078 Major W. E. King, 20th February, 1946.

2nd/14th Australian General Hospital.—SX15732 Major R. H. Elix, 20th February, 1946.

103rd Australian General Hospital.—NX70229 Major J. Z. Huie, 13th February, 1946.

No. 112 (*Brisbane*) *Military Hospital.*—NX113913 Major A. G. Cumpston, 21st February, 1946.

No. 113 (*Concord*) *Military Hospital.*—SX28343 Major R. H. Von Der Borch, 16th February, 1946. Captains NX147233 F. B. Uther, 14th February, 1946, and NX140308 N. F. Babbage, 19th February, 1946.

Inter-Service Medical Wing Demobilization Centres (*Australian Military Forces Component*).—Captains QX61162 G. L. T. Wright, 13th February, 1946, NX153894 T. A. G. Holmes, 12th February, 1946, and SX21676 J. E. Dornan, 20th February, 1946.

Majors VX112208 F. C. H. Ross, 20th December, 1945, and QX39962 W. D. Exton, 9th February, 1946, and Captains P390 G. H. Vernon, M.C., 4th March, 1946, and N120507 W. Moppett, 22nd February, 1946.

2nd/5th Australian General Hospital.—NX242 Major J. F. L. McCulloch, 21st November, 1945.

2nd/6th Australian General Hospital.—NX137121 Captain D. Klineberg, 15th December, 1945.

2nd/9th Australian General Hospital.—NX70164 Major C. W. Furner, 23rd February, 1946.

2nd/11th Australian General Hospital.—VX59036 Major J. E. P. Hogg, 21st February, 1946.

No. 102 (*Holland Park*) *Military Hospital.*—NX147234 Major F. H. H. Wilson, 23rd February, 1946, and QX60278 Captain W. S. Williamson, 23rd February, 1946.

No. 105 (*Adelaide*) *Military Hospital.*—VX63041 Major R. C. E. Brodie, 20th February 1946.

106th Australian General Hospital.—VX114238 Major A. J. M. Nelson, 31st January, 1946.

107th Australian General Hospital.—SX34114 Captain P. W. Leslie, 28th February, 1946.

No. 113 (*Concord*) *Military Hospital.*—Majors NX35128 J. F. C. C. Cobley, 23rd February, 1946, NX12361 B. Moore, 21st February, 1946, and NX76240 A. A. Sharland, 22nd February, 1946 and Captains NX143691 M. Allen, 15th February, 1946, and NFX123385 B. J. McNamara, 22nd January, 1946.

No. 114 (*Goulburn*) *Military Hospital.*—QX23977 Major C. M. McCarthy, 21st February, 1946.

No. 115 (*Heidelberg*) *Military Hospital.*—VX47594 Major B. T. Keon-Cohen, 12th January, 1946.

118th Australian General Hospital (*Australian Imperial Force*).—WX38917 Captain L. F. Healy, 27th February, 1946.

17th Australian Camp Hospital.—NX166458 Captain K. G. Lawrence, 19th February, 1946.

28th Australian Camp Hospital.—V147246 Captain A. G. Liddelow, 1st March, 1946.

54th Australian Camp Hospital.—NX179506 Captain N. E. Creswick-Jackson, 23rd February, 1946.

70th Australian Camp Hospital.—NX137122 Captain C. J. Zimmerman, 13th February, 1946.

3rd Australian Women's Hospital.—NX135426 Major A. R. H. Duggan, 13th February, 1946.

2nd/1st Australian Convalescent Depot.—VX63450 Major D. J. McL. Dunn, 1st March, 1946.

2nd Australian Outpatients' Depot.—VX114293 Major D. H. Bodycombe, M.C., 26th February, 1946, and VFX95435 Captain C. Lee, 22nd February, 1946.

2nd/1st Australian Casualty Clearing Station.—VX135228 Major S. R. Gerstman, 14th February, 1946.

110th Australian Casualty Clearing Station (*Australian Imperial Force*).—SX20146 Major W. B. Dorsch, 1st March, 1946.

2nd/4th Australian Field Ambulance.—NX178926 Captain W. Hillyer, 22nd February, 1946.

2nd/11th Australian Field Ambulance.—SX10405 Major R. H. Hamilton, 26th February, 1946.

2nd/12th Australian Field Ambulance.—WX33063 Captain L. G. Redgrave, 12th February, 1946.

2nd Australian Field Ambulance (*Australian Imperial Force*).—VX94279 Captain A. G. Ley, 1st March, 1946.

19th Australian Field Ambulance (*Australian Imperial Force*).—QX23858 Major D. Watson, 9th February, 1946.

2nd/1st Australian Hospital Ship.—NX103431 Major W. S. McGrath, 22nd February, 1946.

Inter-Service Medical Wing Demobilization Centres (*Australian Military Forces Component*).—WX17082 Major A. P. Davis, 26th February, 1946, and Captains NX104569 J. F. Ireland, 22nd February, 1946, NX76470 J. M. McDonald, 5th January, 1946, NX201124 F. K. C. Keston, 1st March, 1946, NX123747 E. Collins, 1st February, 1946, NX111012 H. R. Macourt, 31st January, 1946, and VX90835 G. Gorr, 27th February, 1946.

Majors NX70506 W. E. Fisher, 12th February, 1946, VX39043 R. H. Stevens, 26th February, 1946, and NX70516 C. R. Furner, 24th November, 1945, Captains NX70664 R. G. Wright, 15th December, 1945, NX76511 P. T. Millard, 12th February, 1946, and VX53704 M. F. A. Woodruff, 19th February, 1946.

The undermentioned officers are transferred to the Reserve of Officers with effect from the dates indicated, and, where applicable, cease to be seconded. Officers holding temporary rank relinquish such temporary rank on the date of transfer to the Reserve of Officers, and are granted from such date honorary rank on the Reserve of Officers equivalent to the temporary rank relinquished.

NFX117869 Captain (Temporary Major) M. Scott-Young, 26th January, 1946, and VX59291 Captain (Temporary Major) P. Kaye, 17th January, 1946.

2nd/2nd Australian General Hospital.—VX131419 Captain (Temporary Major) A. T. Park, 1st February, 1946.

No. 110 (*Perth*) *Military Hospital.*—VX149294 Captain (Temporary Major) T. P. Dawes, 7th December, 1945.

No. 115 (*Heidelberg*) *Military Hospital.*—Captains (Temporary Majors) V10876 A. L. B. Webb, 11th January, 1946, and VX135227 B. L. Deans, 19th January, 1946.

Inter-Service Medical Wing Demobilization Centres (*Australian Military Forces Component*).—Captains (Temporary Majors) NX76537 B. Short, 19th December, 1945, NX116470 R. E. Wherrett, 24th January, 1946, and NX70636 D. L. Cropp, 10th January, 1946.

Captains (Temporary Majors) NX455 A. A. Moon, 12th January, 1946, and NX350 E. L. Corlette, 8th January, 1946.

112th Australian Convalescent Depot (*Australian Imperial Force*).—NX108197 Captain (Temporary Major) M. W. Ginsberg, 22nd February, 1946.

2nd/13th Australian Field Ambulance.—SX22318 Captain (Temporary Major) R. J. Salts, 18th January, 1946.

18th Australian Field Ambulance (*Australian Imperial Force*).—NX118680 Captain (Temporary Major) J. E. G. Channon, 23rd February, 1946.

Retired List.

Australian Army Medical Corps.

The undermentioned officers are placed upon the Retired List on the dates indicated, and, where applicable, cease to be seconded. Officers holding temporary rank relinquish such temporary rank on the date of placement upon the Retired List.

NX204014 Captain G. S. Gurney, 5th January, 1946.

2nd/8th Australian General Hospital.—VX61253 Major W. R. Gayton, 17th January, 1946.

No. 102 (*Holland Park*) *Military Hospital.*—Q123886 Captain F. T. Grainger, 2nd February, 1946.

118th Australian General Hospital.—NX147830 Lieutenant A. E. P. Grimmo, 19th January, 1946.

17th Australian Camp Hospital.—N73123 Major F. C. Rogers, 8th February, 1946.

68th Australian Camp Hospital.—NX122612 Captain C. R. Campling, 7th February, 1946.

Inter-Service Medical Wing Demobilization Centres (*Australian Military Forces Component*).—V113101 Major A. R. Buchanan, 7th February, 1946.

2nd Australian Outpatients' Depot.—V147257 Captain R. F. L. V. Harvey, 23rd February, 1946.

101st Australian Light Field Ambulance (*Australian Imperial Force*).—NX126033 Major W. McP. Roberts, 4th January, 1946.

2nd Australian Blood and Serum Preparation Unit.—NX203390 Captain R. W. McGlynn, 22nd January, 1946.

NG4054 Major N. B. Watch, 12th February, 1946, NX35101 Captain S. E. J. Robertson, 27th February, 1945.

Correspondence.

TRIGEMINAL NEURALGIA.

SIR: From personal experience I can state that removal of the supraorbital nerve has no effect in curing periodical attacks of neuralgia, either the present attack or any which are to follow. From personal experience (about eighteen years of it), I can state that interference with the sensory root of the fifth cranial nerve is worse than useless. This operation will cause the periodic pain to become permanent, persistent and perennial, not only in the supraorbital region, but over the whole distribution of the fifth nerve, varying only in intensity. It will be accompanied by all kinds of distressing paræsthetic symptoms.

Like most medical men, I had a horror of sedatives, but would now be pleased to hear of any drug or combination of drugs likely to give moderately quick relief to the more vicious spasms of pain.

Yours, etc.,
ALEC LYONS.

Eaglehawk,
Victoria,
April 28, 1946.

"THIO" DRUGS IN THYREOTOXICOSIS.

SIR: Since our article "'Thio' Drugs in Thyreotoxicosis" appeared in the journal of April 13, 1946, our attention has been drawn to the fact that two articles on this subject appeared in the *Royal Melbourne Hospital Clinical Reports*, Volume XV, December, 1944, of which we wish to make acknowledgement. Our ignorance of these articles is due to the fact that the reports in question are not included in the "Index Medicus".

The first article is by W. W. S. Johnston, who detailed in full eleven cases, and the second is by Ivan Maxwell, who discusses his experiences in ten cases.

As far as Australia is concerned, we believe these reports rank in priority after the article by Ritchie and Geddes in THE MEDICAL JOURNAL OF AUSTRALIA, April 29, 1944.

Yours, etc.,
HUGH R. G. POATE.
S. L. SPENCER.

225, Macquarie Street,
Sydney,
May 1, 1946.

RESEARCH AT SYDNEY HOSPITAL.

SIR: We would appreciate your bringing to the notice of medical practitioners the following information.

With the aid of a grant from the National Research Council, research is being carried out at Sydney Hospital into the effects of penicillin, local and parenteral, on early acute infections of the hand. Medical practitioners wishing to refer such cases for treatment should first ring the senior casualty surgeon, Sydney Hospital (BW 1291).

Yours, etc.,
NORMAN ROSE,
Medical Superintendent.

Sydney,
April 27, 1946.

SPINAL ANÆSTHESIA AND CHLOROFORM: A COMPARISON OF MORTALITY.

SIR: In his paper "Spinal Anæsthesia and Chloroform: A Comparison of Mortality" appearing in a recent issue of the journal, Dr. Corlette appears to be attempting to infer that the practice of spinal anæsthesia is attended with a greater mortality than the use of chloroform. It is not my intention to discuss the pros and cons of these methods of anæsthesia, but rather to protest against the uncritical use of the data in this so-called statistical study and the unwarranted conclusions presented.

With a disregard for space and time which even Einstein might envy, Dr. Corlette ranges in space from Alexandria to Michigan, and, in time from 1878 to 1942, lumps all the data together, and by means of simple proportion presents a figure purporting to show that spinal anæsthesia is much more dangerous than chloroform anæsthesia of fifty years ago.

The first fallacy is the assumption that every death on the operating table is to be attributed to the anæsthetic. The second is that the patients of today are comparable with those in the zenith of chloroform anæsthesia. Surgical methods and technique have progressed to such an extent that nowadays the aged and many others, whose physical condition even twenty years ago would have classed them as too great a risk, willingly submit to operation. Hence to compare the patients of the chloroform era with those of today is completely unjustifiable. In recent years prostatic surgery under spinal anæsthesia has developed enormously. The mortality is greater than for ordinary operative work on younger patients, but nothing can be adduced from this save the obvious fact that the patients are in a higher risk group. I have no doubt that the military hospitals could produce a set of figures indicating an amazingly low level of spinal anæsthetic misadventures, but it would be just as illogical to use these as it would be to quote the chloroform deaths in obstetric work, as both sets of patients comprise the physically fit members of the community. Hence the comparison of results obtained apart at different dates—in this case about thirty years—is both futile and misleading.

Some of the cardinal maxims in scientific method are that the material should be as homogeneous as possible, the conditions of observation or experiment strictly controlled both as to time and place, and preferably the treatments should be distributed at random within each group. The results when obtained are valid only for the conditions prevailing in that particular experiment or observation. Hence to compare results obtained in Egypt (which were actually used without the mortality being known) with those in America is quite unsound. In fact, a series of 500 cases conducted under the conditions outlined above would give results infinitely more reliable than the 50,000 quoted in this survey.

Dr. Corlette omits also to distinguish between high and low spinal anæsthesia. Very probably the difference between these is greater than that between low spinal and chloroform anæsthesia. The physiological effects of spinal blocks at different levels are quite accurately known, and the anæsthetist can utilize this information when selecting the anæsthetic for his particular patient. This precise information is much more valuable to the anæsthetist (and the patient) than the results of surveys of the mass type with heterogeneous material and methods which Dr. Corlette should have left decently buried in his private note books.

Yours, etc.,
J. E. THOMAS.

Stawell,
Victoria,
April 26, 1946.

SIR: Dr. C. E. Corlette's article in your issue of April 20, 1946, purporting to compare the mortality incidental to chloroform and spinal anæsthesia, is a good example of the way in which statistics may be manipulated to serve any particular bias. As is well known, his bias is towards local analgesia, wherein he enjoys acknowledged eminence and authority. He may also, by virtue of his status as an elder surgeon, be entitled to speak of chloroform in appreciative terms. But when he proceeds, on the basis of two articles fifteen years out of date, to condemn "spinal anæsthesia as at present known" his testimony becomes unreliable.

Many more factors than those examined by Dr. Corlette have an important bearing on the startling results which he has produced with such obvious satisfaction. For instance, two widely divergent periods of time are involved, with all their great variations in the scope of surgical enterprise and daring. The general applicability of the one method has not been adequately weighed against the limitations of the other. No allowance has been made for the differing standards, practices and customs of the two main countries concerned. And, finally, chloroform in its heyday is adversely compared with spinal anæsthesia in its adolescence, a time when it was subject to various misconceptions and abuses.

Dr. Corlette refers to the necessity for a comprehensive survey, and warns against the fallacy of arguing from the particular to the general. Whether these requirements have been satisfied by his reference to so limited a number of authors is open to question. At any rate, he does not seem to have consulted either local figures or opinion, which surely would have afforded him valuable enlightenment.

Yours, etc.,
S. V. MARSHALL.

143, Macquarie Street,
Sydney,
May 2, 1946.

Post-Graduate Work.

COURSE AT ARMIDALE.

THE New South Wales Post-Graduate Committee in Medicine, in conjunction with the Northern District Medical Association, will hold a week-end course at Armidale on Saturday, June 8, and Sunday, June 9, 1946. The course will be held at the New England University College, Armidale. The programme is as follows.

Saturday, June 8.

2 p.m. to 3 p.m.—"Improved Management in Toxæmia of Pregnancy": Professor B. T. Mayes.
3 p.m. to 4 p.m.—"The Serious Thoracic Diseases of Childhood": Dr. T. Y. Nelson.
4.30 p.m. to 5.30 p.m.—"Some Aspects of Therapeutics Old and New"—First Lecture: Dr. S. A. Smith.
8 p.m.—"The Hydro-Electric Development and the Progress of Rural Medical Practice": Sir Earle Page.

Sunday, June 9.

9.30 to 10.30 a.m.—"Sulphonamide and Penicillin Therapy in Children": Dr. T. Y. Nelson.
11.30 a.m. to 12.30 p.m.—"Lower Segment Cæsarean Section": Professor B. T. Mayes.
2 p.m. to 3 p.m.—"Some Aspects of Therapeutics Old and New"—Second Lecture: Dr. S. A. Smith.
3 p.m. to 4 p.m.—"Can We Make Breech Presentation Easier and Safer?": Professor B. T. Mayes.

The fee for the course will be £1 1s. There will be no charge for members of the defence forces. Those wishing to attend are requested to notify Dr. R. J. Jackson, Honorary Secretary, Northern District Medical Association, Armidale, as soon as possible.

COURSE AT THE WOMEN'S HOSPITAL, MELBOURNE.

THE Melbourne Permanent Post-Graduate Committee announces that refresher courses have been arranged at the Women's Hospital, Melbourne, for June, July, August and September, 1946, each course lasting four weeks.

They will consist of lecture demonstrations and practical work, and are specially designed for ex-service medical officers. Those attending will be supernumerary "residents" at the hospital. A tuition fee of twelve guineas will be charged, and residence will be at the rate of £2 10s. per week.

Further details may be obtained from the Secretary, Post-Graduate Committee, College of Surgeons, Spring Street, Melbourne, C.1 (JM 1547).

Nominations and Elections.

NEW SOUTH WALES.

THE undermentioned have applied for election as members of the New South Wales Branch of the British Medical Association:

Flannery, Brian Peter, M.B., B.S., 1943 (Univ. Sydney), 28, Melrose Parade, Clovelly.
Lane, Melva Joyce, M.B., B.S., 1945 (Univ. Sydney), 3, Chevron, 8, Dalhousie Street, Haberfield.
Hendry, Peter Ian Alexander, M.B., B.S., 1939 (Univ. Sydney), 16, Vernon Street, Strathfield.
D'Apice, Mary Dorothy, M.B., B.S., 1945 (Univ. Sydney), 28, Wolseley Road, Point Piper.
Bell, Betty Jeanette, M.B., B.S., 1945 (Univ. Sydney), 4, Gipps Street, Wollongong.

Medical Prizes.

THE STAWELL PRIZE.

THE Stawell Prize, a memorial to Sir Richard Stawell, is open for competition. The amount of the prize is £30. The conditions are as follows.

1. The prize shall be awarded to the writer of the essay adjudged to be the best on a subject selected annually.
2. The subject for 1946 is "The Management of Diabetes Mellitus in Childhood".
3. The dissertation should be based on personal observation and experience of the writer.
4. The competition is open to graduates of any Australian university.
5. The trustees reserve the right to withhold the award.
6. Essays must be delivered to the Medical Secretary, British Medical Association (Victorian Branch), by 4 o'clock p.m. on November 30, 1946.
7. Each essay must be typewritten or printed and must not exceed 75,000 words in length.
8. Each essay must be distinguished by a motto and must be accompanied by a sealed envelope marked by the same motto, containing the name and address of the author.
9. The trustees reserve the right to publish the prize essay.

THE FEDERAL MEDICAL WAR RELIEF FUND.

THE following contributions to the Federal Medical War Relief Fund have been received:

New South Wales.

Canterbury-Bankstown Medical Practitioners' War-Time Protection Fund (J. R. Allison, L. Abramovich, C. G. Bayliss, F. A. Bellingham, S. G. Bradfield, K. Byrne, G. J. Cousins, F. R. Cumming, H. E. Clarke, J. H. D. Edwards, M. L. Edwards, J. C. Green, M. D. Harpur, A. J. Hope, A. R. Hudson, K. J. Howell, R. W. Kelly, H. A. McCredie, R. W. McCredie, M. W. Matheson, G. H. Parker, G. H. Pfeiffer, G. H. Puddicombe, W. D. Quilty, G. Russell, C. S. Rowntree, R. Segal, R. M. Thomson, E. Trenerry, A. E. Yeldham), £515 7s. 9d.

George Bell, £105.
A. C. Thomas, £100.
W. S. Donaldson, £58.
A. A. King, £52 10s.
E. W. Fairfax, K. F. Vickery, £50.
F. O. Stokes, A. Muscio, S. A. Railton and F. W. Bayldon (four in joint contribution), £40.
E. K. Parry, £30.
W. C. B. Harvey, H. B. Williams, £26 5s.
George C. Halliday, J. W. van R. Hoets, T. Dixon Hughes, W. R. Page, £25.
S. H. Scougall, £24 3s.
J. W. S. Laidley and M. S. S. Earlam (joint contribution), H. E. Thomas, R. B. Minnett, K. S. Parker and C. W. S. Dun (four in joint contribution), A. J. Collins, H. M. Rennie, S. Sheldon, £21.
A. I. Branch, W. L. Calov, R. C. Edwards, J. A. James, N. J. Mackay, H. R. Sear, £20.
G. B. Downes, R. Kantor, D. A. Williams, £15.
H. C. R. Darling, Julia Amphlett, Mervyn Archdall, A. L. Bryant, C. K. Cohen, B. A. Cooper, C. J. R. and D. Conacher (joint contribution), F. C. Crossle, H. H. Crowe, Clyde Davis, W. S. Dawson, Emily M. A. Day, M. R. Flynn, J. J. Gilchrist, N. McA. Gregg, A. R. Hamilton, A. E. Harker, H. R. J. Harris, H. H. Harrison, H. R. Hill, R. C. Huntley, T. W. Lipscomb, D. I. Low, W. P. MacCallum, H. T. C. MacCulloch, P. E. McCormack, C. C. McKellar, Alexa Maclean-Lilley, A. J. Murray, L. J. A. Parr, C. N. Paton, Bernard M. B. Riley, Colin C. Ross, J. Ross, N. H. Rutledge and Muriel E. Rutledge (joint contribution), R. Scot Skirving, A. J. H. Stobo, R. Swinburn, D. G. R. Vickery, G. B. White, J. B. Whittemore, C. A. Wiles, G. J. Williams, J. C. Windeyer, R. G. Woods, £10 10s.
J. R. Allison, E. P. Blashki, S. G. Bradfield, Lyle Buchanan, Mary B. Burfitt-Williams, F. A. Burns, Marjorie C. Dalgarno, W. C. Darragh, J. Dawson, P. H. Doyle, J. G. Edwards, L. L. Edwards, A. B. Erby, N. E. Fenner, C. S. Graham, T. M. Greenaway, D. T. Harbison, J. K. Harbison, M. D. H. Harpur, J. A. Holt, A. J. Hope, F. J. Howell, R. T. C. Hughes, A. R. Hunt, J. G. Hunter, J. F. W. Kaw, A. L. Lance, A. Lippmann, N. E. McLaren, P. J. Markell, H. D. Mathews, S. C. Maynard, R. H. B. Millar, I. D. Miller, Aileen Mitchell, H. G. Mitchell, C. W. W. Murray, E. Murray-Will, T. Y. Nelson, W. T. Nelson, H. M. North, C. M. O'Halloran, A. B. S. Owen, E. C. Palmer, C. R. Palmer, R. K. Rae, Eulalia Richards, E. W. Rivett, C. S. Rowntree, G. H. Walton Smith, G. Keith Smith, N. S. Solomons, S. L. Spencer, E. S. Stuckey, A. C. Ternes, E. A. Tivey, J. E. Traill, F. L. Utber, Sir Robert Wade, J. T. Ward, F. H. Watson, D. C. Williams, Kathleen M. Winning, W. Wood, L. S. Woods, £10.
Ettie Lyons, Noel Pryde, £8 8s.
A. D. Forbes, £7 7s.
T. D. Hagger, £6 6s.
C. R. Alexander, Edith E. A. Anderson, R. N. Beasley, H. G. Benson, B. B. Blomfield, G. Bowen-Thomas, M. Brenner, A. Graham Butler, J. H. Carman, A. G. Child and Margaret